ATARI VERSION

1,2,3 MY COMPUTER & ME!

A LOGO FUNBOOK FOR KIDS

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1, 2, 3, MY COMPUTER & ME!

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. . . this book is for you, Jack!

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Dear Parents,

Are you among the growing number of adults who can't understand their children? I'm not talking psychology here; I literally mean that you find yourself unable to follow what your children are saying. Something about RAM or ROM, loops and bugs?! Or have you recently found yourself tightly clutching your quarters, wondering whether or not you should yield to your seven-year-old's plea to play Pac Man$_{TM}$ or Donkey Kong$_{TM}$ "just one more time."

Welcome to the world of the computer! And the fact is — unlike hulahoops and pet rocks — the computer is here to stay. You have to either acknowledge its presence or dig yourself a very deep hole.

Assuming that you choose acknowledgment, then what? Then this book might be for you and your children. **1,2,3, My Computer and Me** isn't a book about machines, at least not in the sense of RAM and ROM and integrated circuits. Nor is it a book about games, although it relishes the value of play. Rather it is a book about learning and is written in such a way that children who use it will want to learn.

1,2,3, My Computer and Me is written in two languages — English and LOGO. LOGO is a computer language that children can learn with relative ease. Through this language they are able to command the movements of a cybernetic Turtle around the screen. These movements reflect the child's understanding of concepts, particularly those that relate to the content of geometry. But more importantly, the movements of the Turtle allow a child to "see" how he is thinking. When the sequence of his thoughts doesn't take him where he intended, the descriptive nature of the LOGO language allows the child to easily retrace his thoughts or to pursue an unintended tangent. Off-computer activities such as designing with cut-out geometric shapes, walking out patterns for the Turtle to draw,or working with a stringboard (directions to make one are included) will help children develop a feel for how to make things happen on the screen.

1,2,3, My Computer and Me invites children into a world of powerful mathematical ideas and into the world of their own thoughts and imaginations. It's an exciting world for children and an equally exciting one for us grown-ups. Why not try it? Join with your child in exploring the LOGO Funbook. Go as fast or as slow as you want. Follow the sequence provided in the book or make up your own. Whatever you do, remember it's a FUNbook. Enjoy it!

Sincerely,
Kathleen Martin, Ph.D.
University of Dallas

A WORD

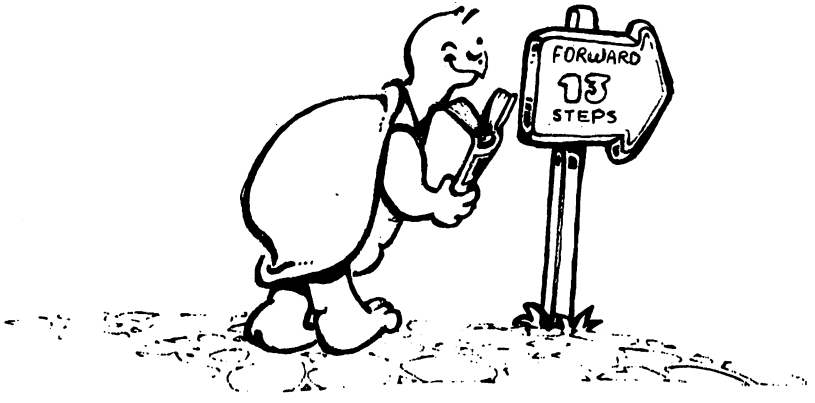
LOGO is a fun computer language for everyone from 2 to 102. The fun part is that YOU are in charge! YOU direct the action! YOU make all the decisions!

To help you get started, we put together this FUNBOOK. When we started, there was only one version of LOGO. Now there are more than a dozen. And each does some thing differently. That is why we wrote this book just for Atari LOGO.

You can start out using this book as your guide through the Great LOGO Adventure. But later on, you may want to keep your Atari LOGO books handy. They will open doors to many more adventures for you.

A lot of young people just like you have helped us. And we'd like your help, too. After you get started, write us a note and tell us what you like to do with LOGO, or just say "Hi!" We'd love to hear from you...

Young Peoples' LOGO Association
P.O. Box 855067
Richardson, Texas 75085



THIS IS MY LOGO FUNBOOK

Hi! I'm Logy, the YPLA turtle. You'll meet my friend, Morf, the YPLA rabbit, when you turn a page or two. We're all going to have a lot of fun with Atari LOGO.

Go ahead and write in this book. But I think you will find that it is even more fun it you make up your own Atari LOGO Journal. That can be your very own, very private diary of all of the things you made up while working at the computer. It's fun going back later to see how you did things. Your Journal is also a good place to do some of the other off-the-computer things we'll talk about in our FUNBOOK.

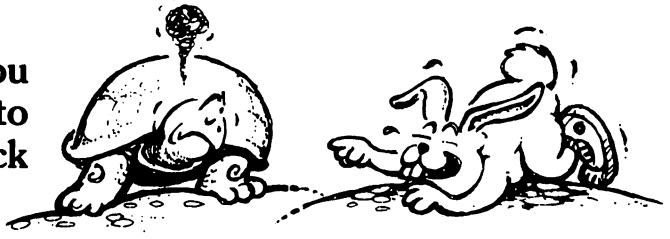
So, are you ready? Then turn the page!

THE TORTOISE AND THE HARE
A COMPUTERIZED UPDATE

Once upon a time, there was a tortoise who moved very slowly but steadily along. He enjoyed his slow, easy life, learning from every new tree and every new experience. Once upon that same time, there was a hare who leaped and hopped all about. Now, the hare was always teasing the tortoise for his slow, steady pace, but the tortoise never replied. He just kept minding his own business, moving steadily forward step by step, learning from each new sight and sound.

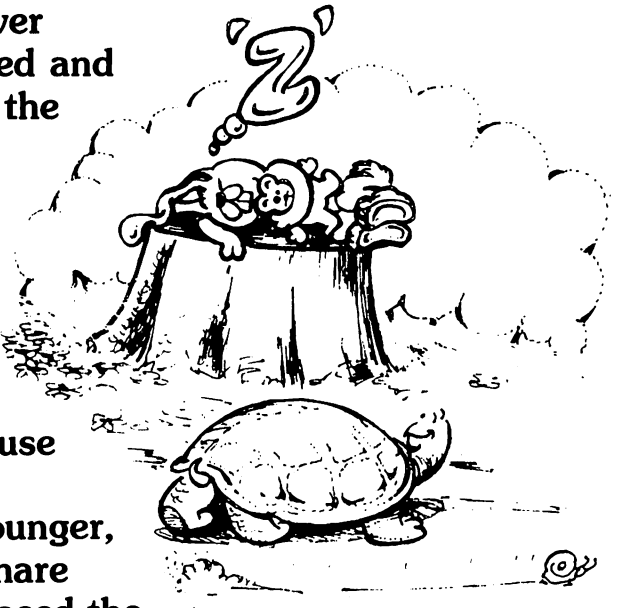
But, one day the tortoise just had it with the hare who had teased him one too many times.

"Hare," he said, "I challenge you to a race. Whoever can make it to the other side of the forest and back first is the winner."

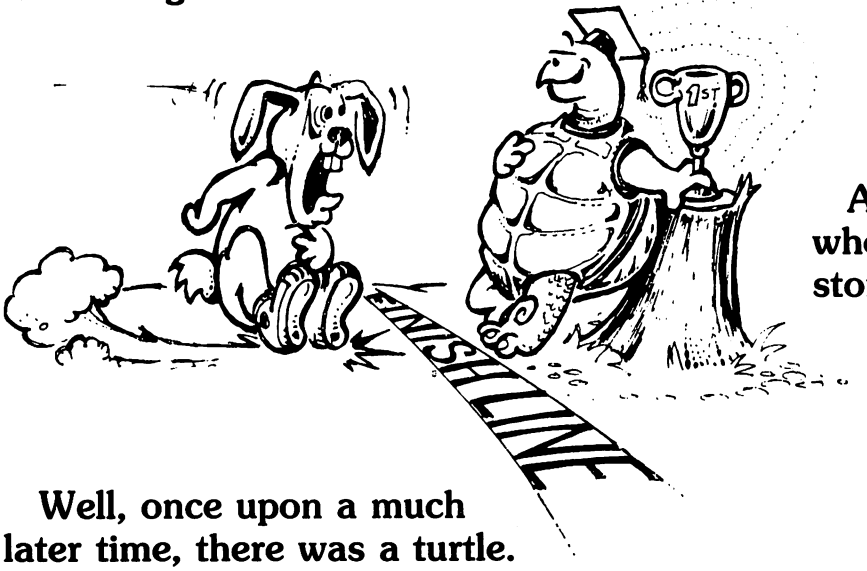


The hare laughed so hard he had to hold his sides and roll on the ground. He readily agreed, and the race began.

The Tortoise started off at a slow, but steady, pace...step...step...step...never faster, never slower. The hare leaped and hopped and did cartwheels around the tortoise and then sped off towards the other side of the forest.



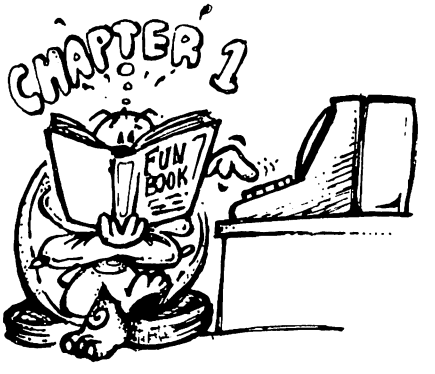
As you have probably already guessed, or you already knew because someone read the real version of this story to you when you were younger, the tortoise won the race, and the hare was very embarrassed and never teased the tortoise again.



And that's probably where you thought the story ended.

Well, once upon a much later time, there was a turtle. He was a distant cousin of the grandchild of the now-famous tortoise. And, of course, there was a rabbit (a distant cousin of the grandchild of the now-infamous hare).

Both the turtle and the rabbit were given the opportunity to learn about computers and Logo. They were both delighted and could not wait to see what they could do.



The turtle began to explore Logo and the computer, one step at a time.

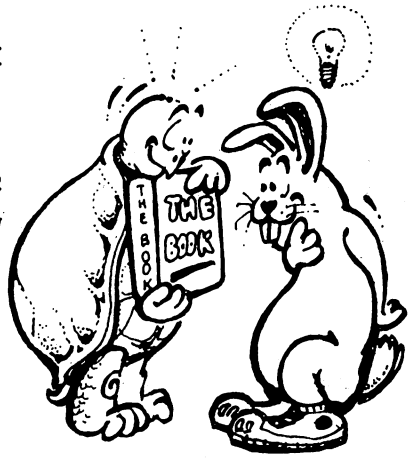
The rabbit glanced at the first chapter of the *Funbook*, which was such an easy chapter that he understood it at once. He bounced from one to another, back and forth, and then he glanced over at the turtle who was still on chapter one.

"Hey, that's easy stuff," he said. "Look at this!"

The turtle was impressed with what the rabbit could do, but he was having just as much fun on his own. He seemed to know that if he kept working along steadily, he would eventually be able to do the marvelous things the rabbit copied from the *Funbook*.

Days passed, and the rabbit was still bouncing from one thing to another. By now the turtle was up to chapter two.

One day, the rabbit glanced over the turtle's shoulder. He was just about to say, "Are you still on the easy stuff?" But, when he saw the screen, he looked puzzled and said, "Hey! How'd you do that?"

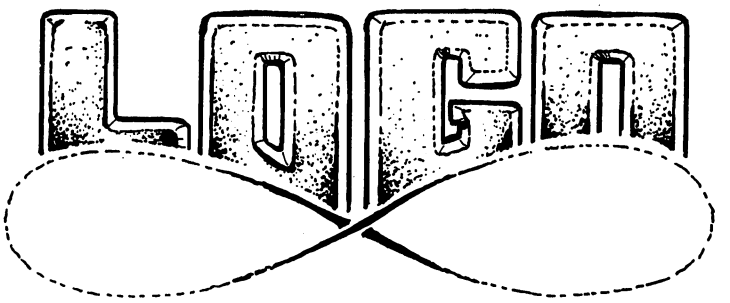


The turtle explained slowly, step by step what he had done to make the wonderful procedure on the screen, but the rabbit did not understand. That wonderful procedure was no where in the book. He knew because by now he had tried every example in every chapter.

"But, Rabbit," explained the turtle, "my procedure's not in the book. I made it up."

"But how did you do that?" questioned the rabbit. "How did you know what to do?"

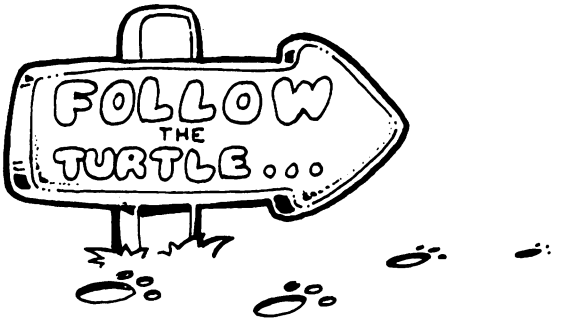
"Gee, I thought you knew, Rabbit," said the turtle as he turned the page to chapter three. "Logo is the most fun when you start with what you know and then learn to use that knowledge to build other things."



"Logo is a language that allows you to explore all of the wonderful things a computer can do. You can't fit all of that into just one book. Logo is not like BASIC, just a small number of commands that you must use within the same program," said the turtle. "Logo is a language of imagination. If you want the computer to do something, all you have to do is teach it how — really!"

"Let's face it, Rabbit. BASIC was old when your father was your age. We've come a long way! Now, we can talk to the computer in our own everyday language. We can design our own language to mean what we want it to mean. If we want to draw complicated pictures, all we have to do is start out with simple commands like FORWARD, BACK, LEFT and RIGHT. If we want to make word games or write other messages, all we have to do is teach the computer how," the turtle added. "Now, why don't you go back to page one of the *Funbook* and start at the beginning. You might even learn something."

The poor rabbit was embarrassed enough for one day. He was not about to be outdone again. He sat down with the *Funbook* and began to read. Soon, he saw that he could design his own complex geometric figures. He began to enjoy his procedures. Mistakes were not embarrassing; they were where the fun began. When he finally got his procedure to run correctly, he did a couple of cartwheels and called the turtle over to see.



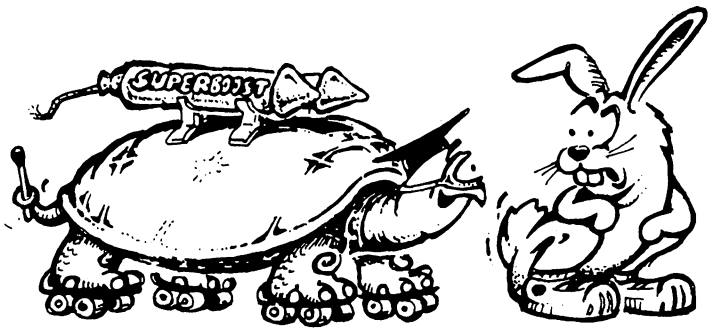
"Hey, that's the idea," said the turtle. "You know, Logo makes learning a lot of fun. It is a language all its own that makes solving problems easy."

"Yes, you know I used to think that arithmetic and mathematics were just a bunch of tables and formulae that were a pain to memorize," said the rabbit. "But this begins to make a lot of sense. Not only that, but many other things fit together in an organized way. But, Turtle, how did you know all of that so fast?" asked the rabbit.

"Rabbit," answered the turtle. "I have to be honest with you. See that shape on the screen? That's really my cousin, Ernestine. She's the Logo turtle who makes all of these great Logo pictures. Let's just say it runs in the family."

As we wrote this book, we tried to think about both the turtle and the rabbit.

What we really hope is that you will follow the turtle. He spent a lot of time on each page and really learned it before moving on to the next. He didn't stop with our examples but made up his own. And when he got to the end of the book, Boy!! Could he make up some neat designs! In fact, we've asked **him** to write the next book!



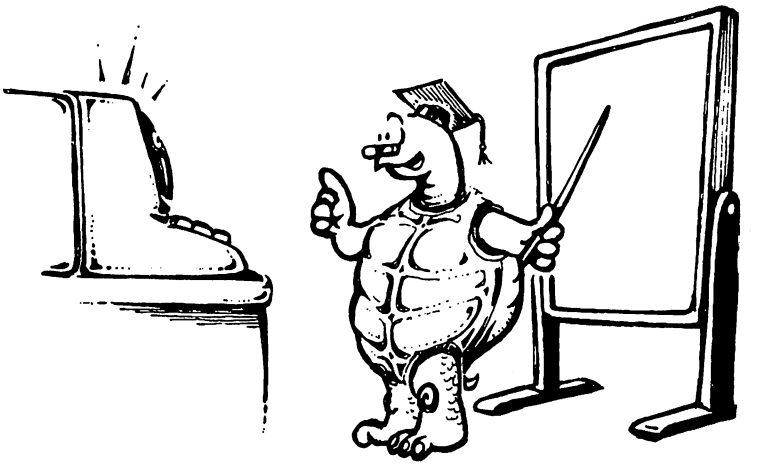
CHAPTER 1
MEET THE TURTLE

One was a turtle, a fellow quite fine.
He drew shapes for Carlos while trailing a line.

LEARNING COMMANDS

Let's get started!

Do you have the Atari LOGO cartridge plugged into the computer? Is the computer turned on? Good, then let's go.



Type: ST

Presto! There's the turtle ready and waiting for your commands! He's at HOME in the center of the screen. He knows four commands:

FORWARD or FD

BACK or BK

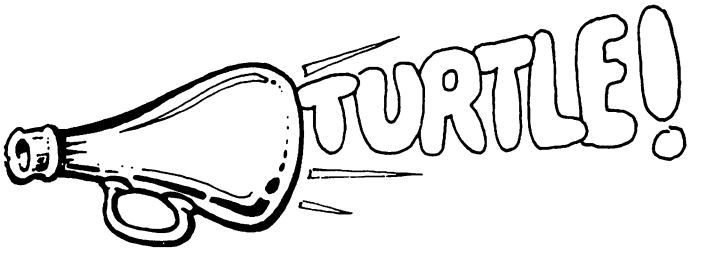
RIGHT or RT

LEFT or LT

Each of these commands must be followed by a space and a number. The number tells the turtle how far to go or how much to turn. Every time you give the computer a command, you must press:

RETURN

That lets the turtle "hear" you.



Any time you want to clear your screen and start over, type CS. That's short for clear the screen. If the turtle has wandered away from the center, you can bring him back by typing HOME. (Remember to press RETURN so he'll hear you.)

Try a few commands:

FD 118

RT 25

BK 72

LT 95

FD ____

LT ____

BK ____

____ ____

____ ____

____ ____

Did you ever type a letter that you didn't mean to type? Here's what to do:

Press the BACK S key to erase the letter or number to the left of the cursor. The cursor is that white square that moves every time you type something on the keyboard.

Want to move the cursor?

OK, just press the CTRL key on the left and one of the Arrow keys on the right to move back and forth. You can only move up and down while you're in the Atari LOGO Editor. We'll talk more about that later.

Sometimes you'll see a message like this.

I DON'T KNOW HOW TO _____

That means the turtle needs some help understanding what you want to do. Did you forget to put a space between the FD and the number? Did you type FB instead of FD? No problem! Just type your command again. The Turtle is very patient. If you haven't seen the message yet, why don't you go ahead and type FB 20 so you can see it.

Suppose you want to move the turtle without drawing. He knows a command that makes that possible:

PENUP or PU

After you move the turtle where you want him, use PENDOWN or PD to tell him to draw again.

Try this:

PU

FD 50

PD

FD 25

RT 30

FD 25

Now add your own numbers!

PU

RT ___

FD ___

PD

___ ___

___ ___

Suppose you want to erase one line without erasing your whole drawing. The turtle can do that, too. The command is:

PX This is short for pen erase.

After you give the command, have the turtle go back over the line you want erased. Try it!

Try this:	Now try this:
FD 50	RT 90
RT 45	FD 50
FD 70	LT 90
PX	FD 100
BK 70	PX
PD	BK 50
____ ____	PD
____ ____	LT 90
FD 50	____ ____
	____ ____

Do you realize you have already learned nine commands?! Can you name them?

_____ or ____

_____ or ____

_____ or ____

_____ or ____

_____ or ____

_____ or ____

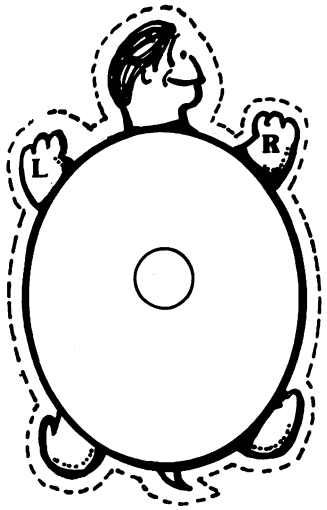
_____ or ____

_____ or ____

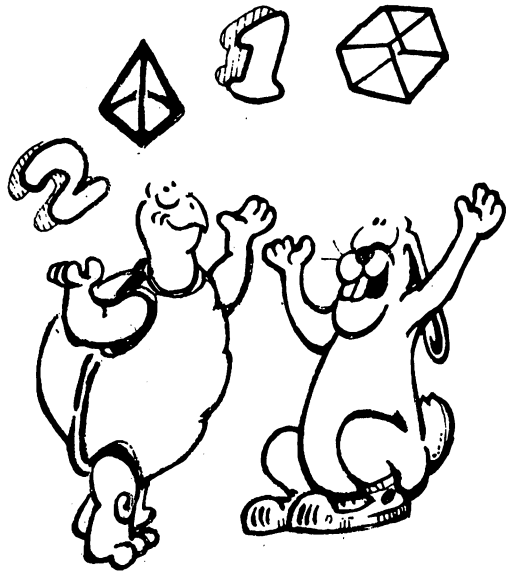
_____

How about that!

You're doing just great. Before you know it, you'll be drawing all sorts of things all over the screen. To get some practice, why not cut out the little turtle at the bottom of the page. Paste it to some cardboard and then punch a hole in the middle. Push this onto your pencil over your hand. Then your hand can play turtle. When you want to turn the turtle, turn your pencil in that direction.



This is really great on graph paper. Go ahead. Try it. It's fun!



Let's use all those commands we've learned. Let's EXPERIMENT! You'll see that word a lot in this book. It just means to play around a lot with different numbers, commands, shapes, and all those other fun things.

Here are some ideas to get you started and some space to write down your own ideas.

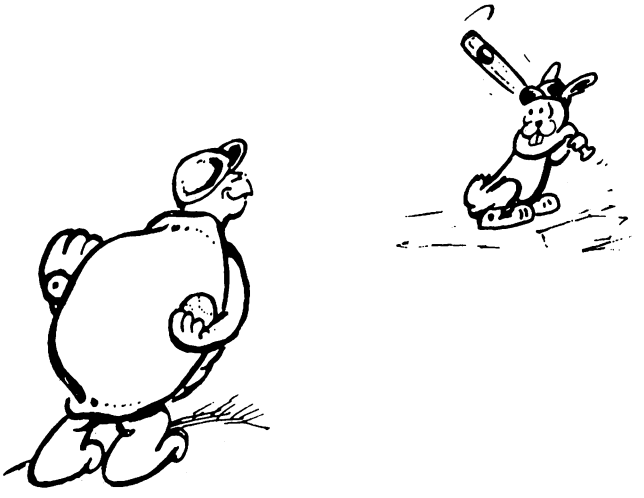
EXPERIMENT 1 Introduce Yourself to the Turtle.

Can you make the turtle draw the first letter of your name?

HAPPY

EXPERIMENT 2 Turtle Baseball

Put four stickers on the screen in the shape of a baseball diamond. Home plate should be at HOME. See if you can make the turtle "run" the bases. This is a good game to play with a friend. Try to make it around with the least number of commands.



EXPERIMENT 3 How Big is the Screen?

Starting at HOME, how many steps can the turtle take before he goes off the top of the screen and appears at the bottom? (That's called **wrapping.**) How far can he go to the left before he wraps around and appears at the right? Can you point him to the upper righthand corner and see how many steps he can take?

Now make up some experiments of your own!

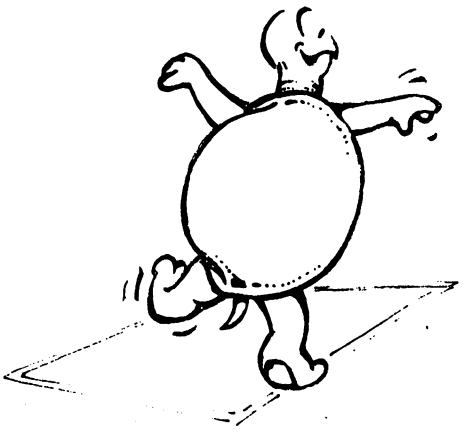
EXPERIMENT 4

EXPERIMENT 5

EXPERIMENT 6

MAKING SHAPES

Now that you've had lots of practice with all those commands, let's put some of them together to make a shape. How about a square? If you were the turtle, how would you draw a square? Stand up and pretend you're the turtle. Whenever you're trying to figure out how to tell the turtle to do something, it helps to "play turtle." Stand up and walk through the motions yourself or tell a friend how to do it. Then it's easier to figure out the commands for the turtle.



OK, play-turtle, walk in a square. Did you go forward, turn, forward, turn, forward, turn, forward, turn? That's exactly what the turtle will have to do. The question is how far to go forward and how much to turn. Do you want a BIG square or a small square?

I want a _____ square so I'll go FD ____

Now, how much do you turn?

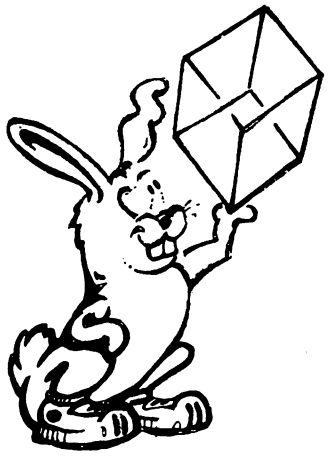
EXPERIMENT. Can you make a square corner?

Since we're trying to figure out how much to turn, keep the FD number the same each time and just play with the RT number.

FD ____

RT ____

FD ____



Does it look like a square corner? It's also called a right angle, even though you can make one by turning left, too. If it doesn't look like a right angle, clear your screen and try again.

Write down the numbers you try and whether they are too big (turned too much) or too small (didn't turn enough).

I tried these numbers:

____ was too _____	____ was too _____
____ was too _____	____ was too _____
____ was too _____	____ was too _____
____ was too _____	____ was too _____
____ was too _____	____ was too _____

THE ANSWER IS _____!!!

Now I can make a square:

FD ____ RT ____ FD ____ RT ____ FD ____ RT ____ FD ____ RT ____

It's a good idea to have the turtle end up facing the same direction he started. That's why we included the last RT turn.

Give yourself a pat on the back or a double-dip ice cream cone! You've worked hard!

If you made a big square, now try to make a small square. If you made a small one, try to make a giant one! Will you have to change the FD number or the RT number? Time for some more experimenting!

This is how I made a BIG square:

FD ____ RT ____ FD ____ RT ____ FD ____ RT ____ FD ____ RT ____

This is how I made a little bitty square:

FD ____ RT ____ FD ____ RT ____ FD ____ RT ____ FD ____ RT ____

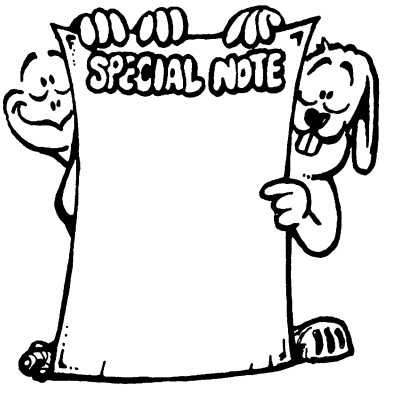
And I even made a middle-size square:

FD ____ RT ____ FD ____ RT ____ FD ____ RT ____ FD ____ RT ____

It seems like it takes a lot of typing just to make a square. Let's try a short-cut. It's called a REPEAT command and it looks like this:

REPEAT 4 [FD ____ RT ____]

(Fill in the FD number depending on what size square you want. And you just figured out that to make a square, the turtle must always turn ____.)

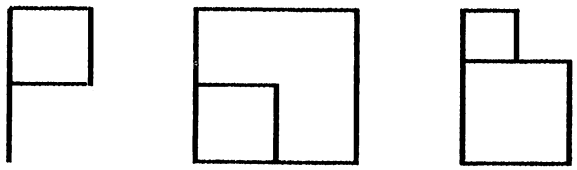


SPECIAL NOTE

If you use parentheses instead of brackets in this command, it confuses the turtle and he doesn't know what to do.

Hey! Can you make a square inside a square? How about a big square on a small square? Can you use PENUP and PENDOWN to put a square in each corner? How many things can you do with squares? 27? 39? 977?

These are some things I can do with squares:



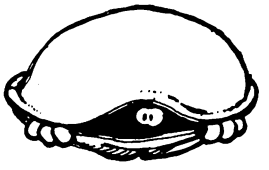
Did you ever realize all the things you can do with squares?! Wow! Don't forget to write down your experiments!

OK! Are you ready to tackle a triangle? Triangles have three sides and three corners or angles. All the sides can be the same length or they can be different. If the sides are all the same, all the angles will be the same. If the sides are different, the angles will be _____. (If you said "different," you are absolutely correct!)

Let's try the one with equal sides and equal angles. If you want to impress your Mom, it's called an **equilateral triangle.** "Equi" means equal and "lateral" means side — equal-side. Enough about words; on with the action.

EXPERIMENT. Try to figure out how much the turtle will have to turn to make an equilateral triangle. In order to see if the third line meets the first, you might want to make the turtle disappear. Don't worry, though; you can call him back anytime you want. To make him disappear, use:

HIDETURTLE or HT



To make him come back, use:

SHOWTURTLE or ST

Ready — Set — GO!

FD 50

RT ____

FD 50

RT ____

FD 50

RT ____

HT

(Use the same number for all three turns.)

(Remember to have the turtle end up facing the same direction he started.)

Try some numbers. If the number is too big, the third line will cross the first. If the number is too small, the third line won't meet the first.

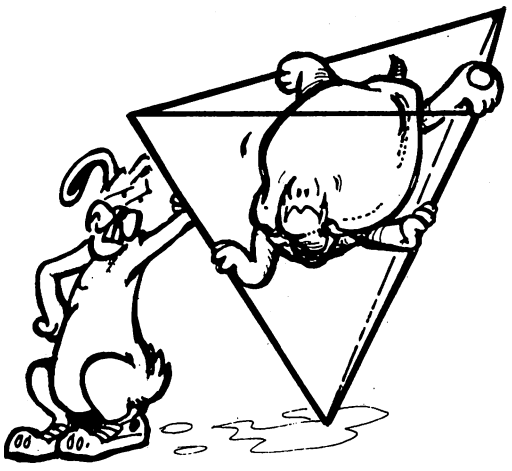
____ was too _____	____ was too _____
____ was too_____	____ was too _____
____ was too _____	____ was too _____
____ was too _____	____ was too _____
____ was too _____	____ was too _____

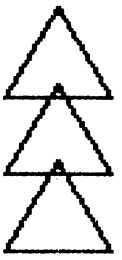
THE ANSWER IS _____!!!

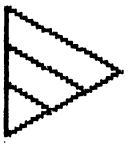
WOW! You did it! Now can you figure out how to do the REPEAT command for a triangle?

REPEAT ____ [FD ____ RT ____]

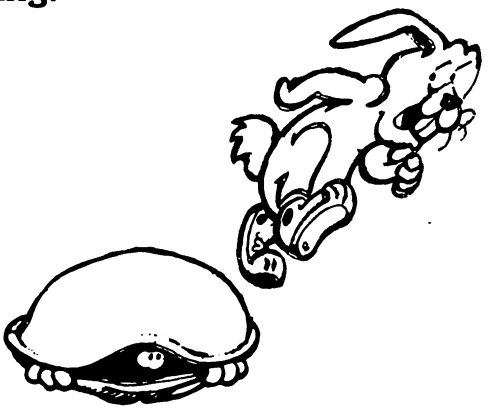
13 or More Things I Can Do with Triangles







Do you know what an open-book test is? It's a test not so much to see if you can memorize a lot of facts and figures but to see if you know where to find the answers. In other words, you can keep your book open and look up the answers. Many times it's a lot more important to know where to look for information about something than it is to know all about that particular something.



We might try a few of those things as we play through this book. We won't use the word "test" because it scared the rabbit all the way to Mississippi and even the turtle got a little nervous. We already had a what-cha-ma-call-it back when we listed all the commands we had learned and I bet you didn't even get sweaty palms. So try a few questions on squares and triangles:

A square has ____ sides and ____ angles.

A triangle has ____ sides and ____ angles.

To make the corner (angle) of a square, turn ____.

To make the corner (angle) of a triangle with three equal sides, turn ____.
(A triangle with three equal sides is called an _____ triangle.)

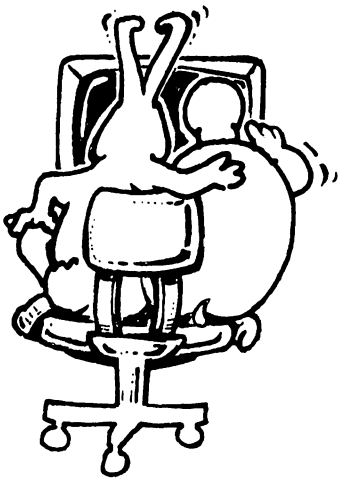
If you add the angles of a square, you get _____.

_____+_____+_____+_____=_____

If you add the angles of a triangle, you get _____.

_____+_____+_____=_____

Hmm, I wonder if that's important...



PLAYING GAMES

Learning LOGO is especially fun if you're learning with a friend. Can you and your friend make up some games using the commands you've learned so far? Here's a game made up by a seven-year-old:

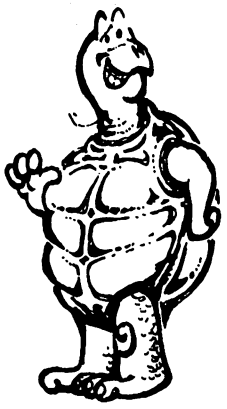
Connect the Shapes

Using the PENUP and PENDOWN commands, the first player draws three or four small shapes anywhere on the screen. The second player then tries to connect them with the least number of commands. If you overshoot your mark and have to back up, that counts as two moves.

Add to My Drawing

Each player can give the Turtle two commands. Take turns and see what happens.

A Game I Made Up!

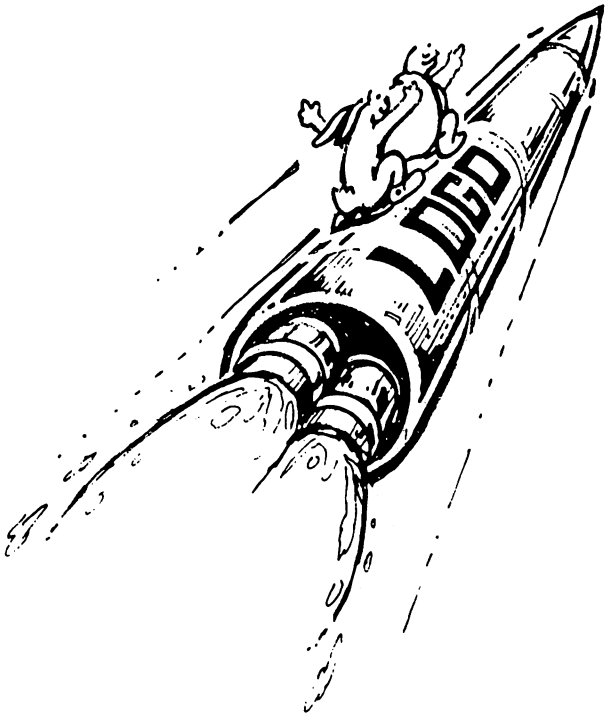


A Game My Friend Made Up!

Here's a simple doodling game. Copy it into your computer and then type DOODLE. When you see the turtle, type a number and watch the turtle move around the screen. Change his direction with R or L. U and D will pick up the pen or put it down. C will clear the screen. Have fun doodling. And then explore more of your Funbook to learn about the commands you have used.

```
TO DOODLE
SET.UP
MOVE
END

TO SET.UP
MAKE "STEP 0
CS FS
END

TO MOVE
FD  :STEP
COMMAND
MOVE
END

TO COMMAND
MAKE "KEY GET.KEY
IF  :KEY = " [STOP]
IF  :KEY = "R [RIGHT 30 STOP]
IF  :KEY = "L [LEFT 30 STOP]
IF  :KEY = "U [PENUP STOP]
IF  :KEY = "D [PENDOWN STOP]
IF  :KEY = "C [SET.UP STOP]
IF NUMBERP  :KEY [MAKE "STEP  :KEY] [STOP]
END

TO GET.KEY
IF KEYP [OUTPUT RC]
OUTPUT [ ]
END
```

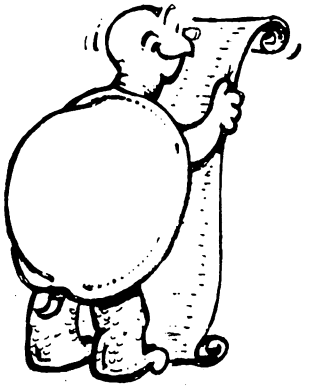
CHAPTER 2
TEACH THE COMPUTER



Two was a HOW TO, a wonderful trick.
Stacy and Carrie took off real quick.

WRITING PROCEDURES

Now that you know the basic turtle commands, you're in for some real fun. You can make up your own commands and teach them to the turtle. Let's start with a square again. We'll teach the turtle to draw a square everytime we give it a certain command. We can name the command anything we want to: SQUARE, BOX, ALFRED, ELIZABETH....



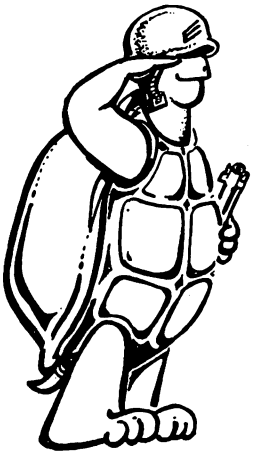
For this example, we'll use BOX since it's easy to remember and easy to type. We'll make it 50 turtle steps on a side for starters. Later you'll learn how to change the 50 to any number you want. Ready? Type:

TO BOX

and press RETURN

Wow! The question mark disappeared and now there's a little > there. How about that!

Now type in the instructions for making a square and press RETURN. Then type END and press RETURN. You'll see the message BOX DEFINED.

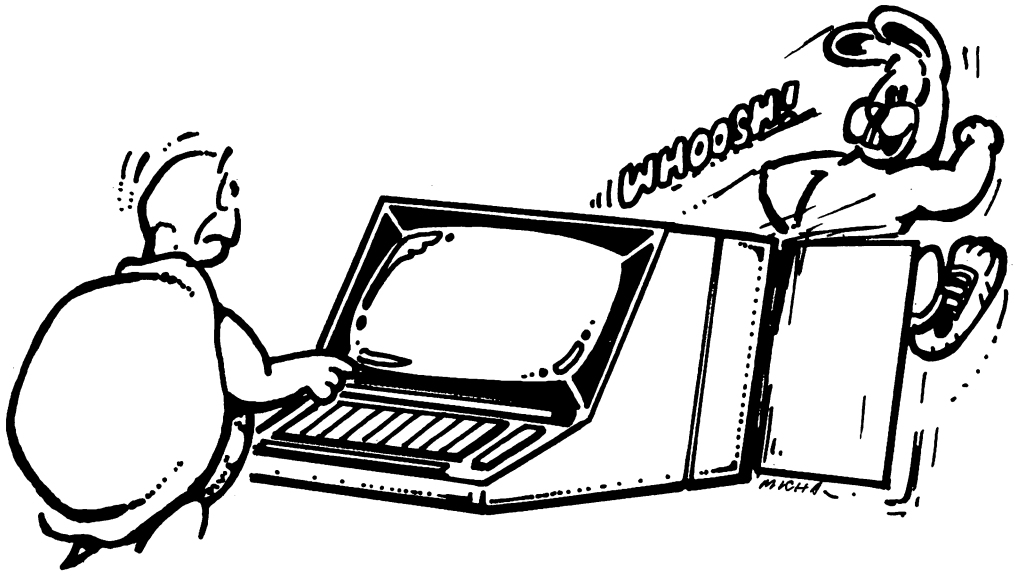


You have now defined a procedure called BOX. Type BOX, press RETURN, and watch how obedient that little turtle is!

EDITING

There may be times you want to change the procedure. Maybe you want the turtle to draw smaller boxes or BIGGER ones. In that case you will have to edit the procedure. Here's how:

Type EDIT "_____ (the name of the procedure you want to edit.) Press CTRL and the right arrow key to get just past the word or number you want to erase and the BACK S key to erase it. Then type in the new word or number. To leave the Atari LOGO Editor, press the ESC key.



Go ahead. Give it a try. Edit the BOX procedure so the turtle will draw a bigger box.

Can you make the turtle draw a smaller box?

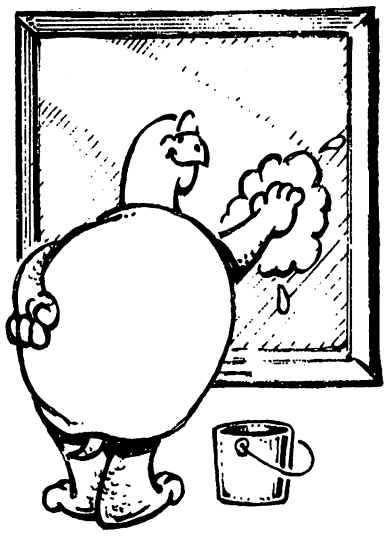
SAVING PROCEDURES

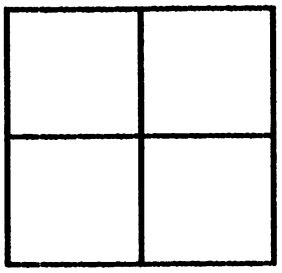
The procedures you teach the turtle will be very helpful in drawing designs and pictures so you might want to save them on a disk or cassette tape. Your Atari manuals will tell you how to set up your tape recorder, and how to format a disk.

BACK TO BOXES

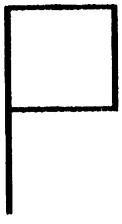
Try putting BOXes all over the screen. Line 'em up. Stack 'em up. Do all kinds of things. Here are a few ideas for you to try and plenty of space to write down what you do. Don't forget to make up some of your own!

Sidewalk

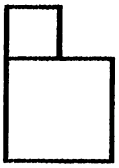




Window

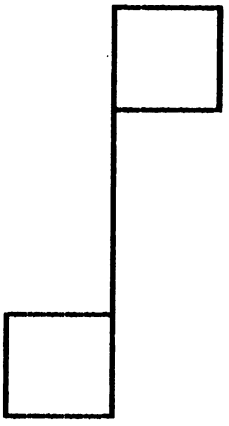


Flag



Stack

Doubleflag



That was so much fun, let's try a triangle. Let's call it TRI since that's easier to type. Do you remember the steps for defining a procedure?

First type TO TRI and press _____.

Type the instructions for a triangle. They are:

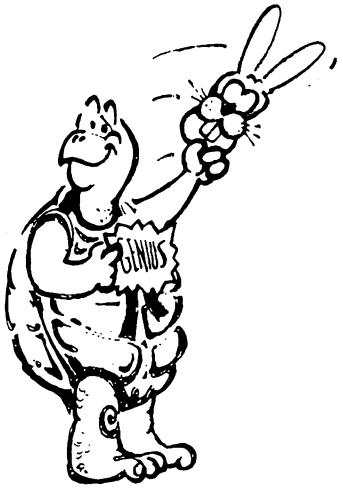
REPEAT ____ [FD ____ RT ____]

To define the procedure and leave the Atari LOGO Editor:

Type _____

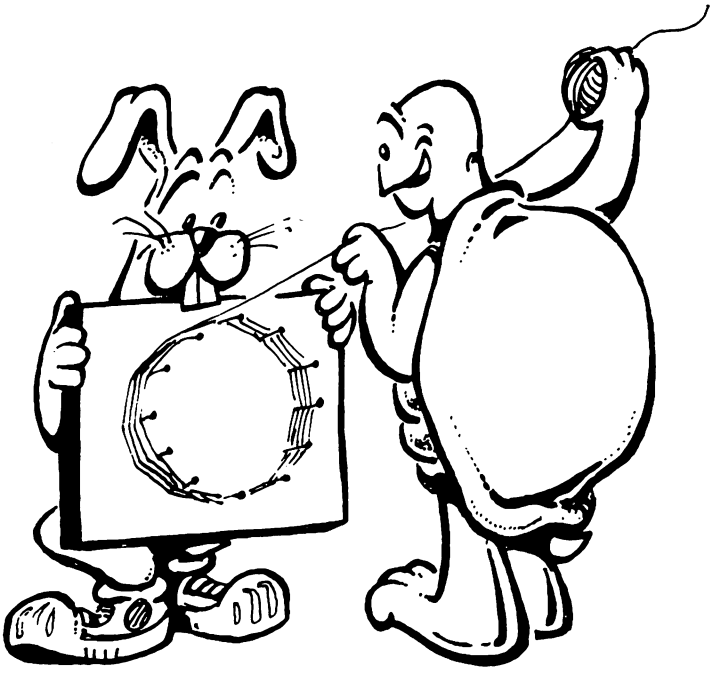
Slipped another one of those open-book thing-a-ma-jigs in on you. How did you do?

A. Super
B. Great
C. I'm a genius in disguise.



STRING BOARD

There are many ways to figure out designs for your turtle to draw: pencil and paper, cut-out paper shapes, string...Sometimes the hardest thing to figure out is how much the turtle should turn. Here's something that's fun to make, fun to play with and will help you figure out turtle turns all at the same time — not bad for a piece of scrap lumber, a few nails and a piece of string!



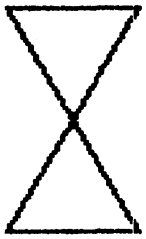
Find a board and cut it to about nine inches by nine inches. Draw a circle on the board and mark it off like you would a clock. Hammer a nail into the circle at each of the marks. Hammer another nail into the center. Tie a loop in one end of your string or yarn. The string represents the turtle trail, and you can make all kinds of designs with it. The center nail is HOME, so start with the loop over that nail. Try an hour-glass and then a hexagon, a six-sided figure.

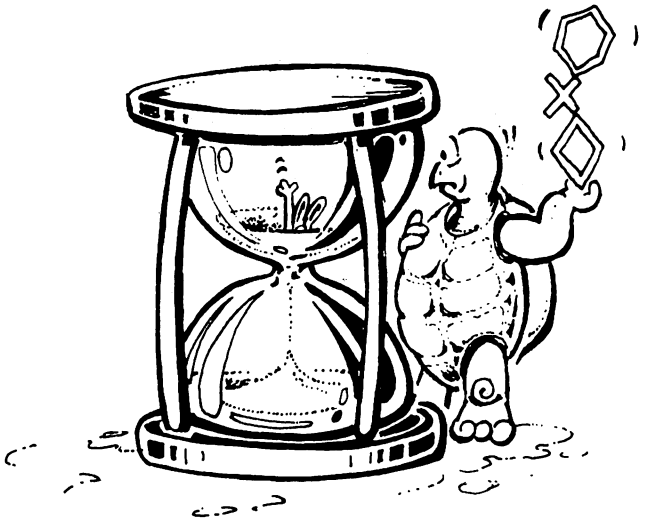
If you start the string at 12 o'clock and go to the center and then to 3 o'clock, you've made a square corner! Remember how the turtle makes a square corner? He turns 90. If the turtle is at HOME facing 12 o'clock and turns to face 1 o'clock, how far will he turn? Since the space between the 12 o'clock and the 3 o'clock is divided into three equal sections, we could divide 90 by 3 to find out. Let's try it on the computer and see if it works.

With the turtle at HOME, go FD 40 and BK 40. The turtle is back at HOME still facing the same way he started. Now turn RT 30 (90 divided by 3) and go FD 40 and BK 40 again. Continue turning RT 30 and drawing another spoke by going FD 40 and BK 40. How many spokes do you end up with if you go all the way around? Hey, just like a clock! Ah ha! That means if the turtle is facing 12 o'clock and turns to face 11 o'clock he turns LEFT ____. So if you want to make an hourglass, the first command would probably be ____ ____. You can use your string board and the clock concept to help you figure out lots of turtle turns!

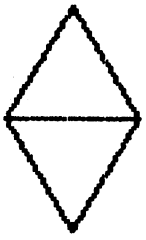
Can you figure out how to do these triangle designs?

Hourglass

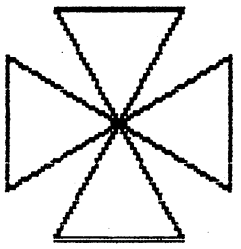




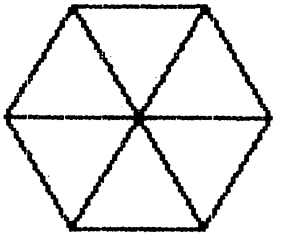
Diamond



Cross



Hexagon

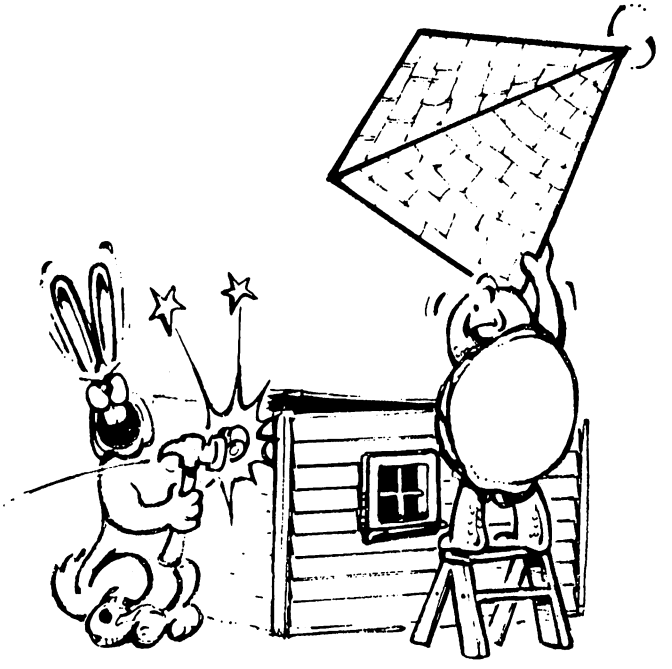


Now that your turtle has had lots of practice with squares and triangles and some of the 1001 things you can do with them, let's use them together. Using PENUP and PENDOWN (PU and PD), can you fill the screen with squares and triangles?

Use this page to draw something using both squares and triangles.

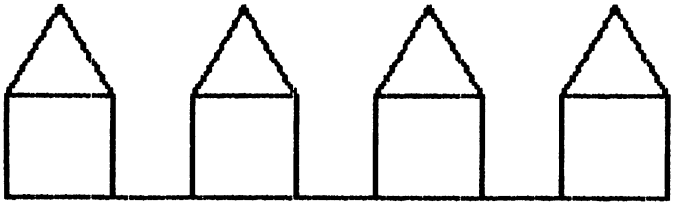
Now let's pick a simple shape and teach the turtle how to draw it with our BOX and TRI commands. By putting a triangle above a square we can make a simple house. If we work at it real hard, we can probably figure out how to write a new procedure called HOUSE. This is not quite as easy as it looks. The rabbit got discouraged after the first try. The turtle figured out that the first command for HOUSE is BOX. He had to experiment quite a while to figure out the rest. He knew one of the commands would be TRI. Can you help him?

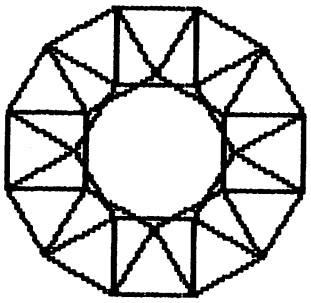
```
TO HOUSE
BOX
_____
_____
_____
END
```



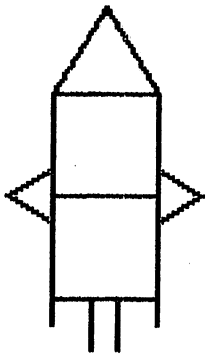
Here are a few things the turtle did with the HOUSE command after he worked it out. Can you figure out how he did them?

Neighborhood



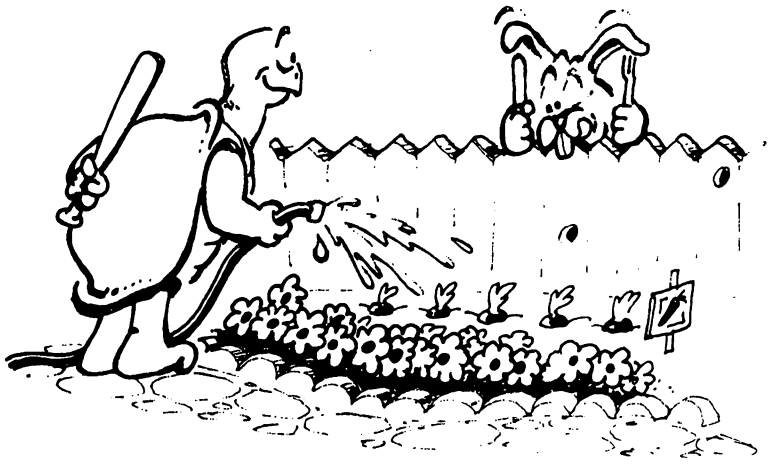


Wheel



Rocket

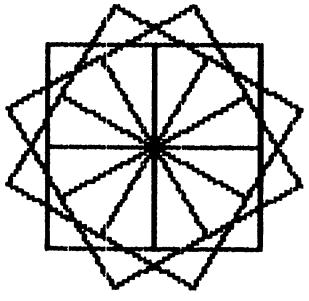
My own designs:



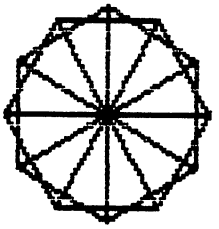
FLOWERS

Did you know turtles really like flowers? Rabbits like them too, but usually they're growing in someone else's garden.

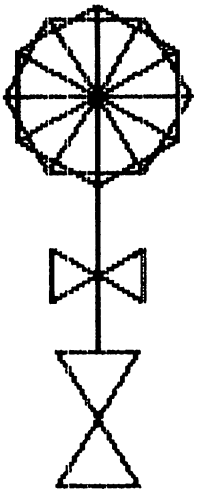
The turtle figured out how to spin BOX so it looked like a flower. He drew one BOX, turned RT 30, drew another BOX, turned RT 30, etc., until he got all the way around. Why don't you try it! Then try it with a RT turn of 20 or 10.

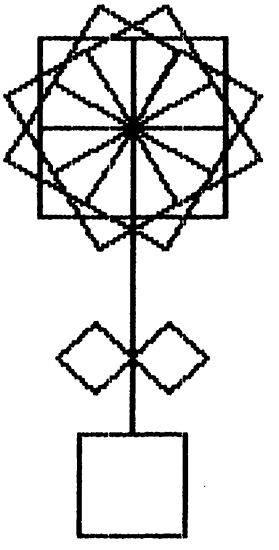


Can you do it with a triangle?

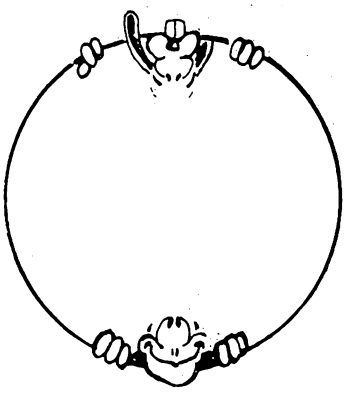


Can you draw a flower at the top of the screen and then, using PENUP and PENDOWN, add a stem and leaves, and maybe even a flower pot?





CIRCLES



Did you notice that when you spun the square it almost became a circle? Or at least the overall design is circular. Let's try to teach the turtle to draw a circle. Time to play turtle again. Stand up and walk in a circle. Did you go forward one step and turn a little, go forward one step and turn a little more? Did you repeat that until you got all the way around?

Now try to make the turtle do the same thing on the screen. How many times would he have to repeat [FD 1 RT 1] to make a complete circle? Try some numbers:

REPEAT _____[FD 1 RT 1]

Write down the numbers you try. Either you can clear your screen and try a different number each time, or you can keep adding to what you've already done. Be sure to write down the numbers and add them up to figure out the grand total. In other words if you start out by trying REPEAT 10 [FD 1 RT 1] and that's not enough, you might want to try REPEAT 20 [FD 1 RT 1]. You have now repeated the command in the brackets 30 times. Here's some space to write down the numbers you try and to draw some shooting stars when you figure out the right number.

REPEAT ____ [FD 1 RT 1]

REPEAT ____ [FD 1 RT 1]

REPEAT ____ [FD 1 RT 1]

REPEAT ____ [FD 1 RT 1]

REPEAT ____ [FD 1 RT 1]

REPEAT ____ [FD 1 RT 1]

THE ANSWER IS _____!!

Ah ha! Remember when we wondered earlier if that number was important? There it is again!

What would happen if you changed 360 to 180? Try it! Draw a picture of what happened:

Let's try something with REPEAT 180. Try changing the other numbers in the command one at a time. Is there a way to make a circle if the REPEAT number is 180? Remember to write down any experiments you try.

What if we changed the REPEAT number to 90?

REPEAT

By now you've probably figured out that there are several different ways to make a circle — you already know three and you've also probably figured out if you change the REPEAT number, you'll also have to change the _____ number. See if you can figure out the missing numbers in these circle commands:

REPEAT 180 [FD 1 RT _____]

REPEAT 72 [FD 1 RT _____]

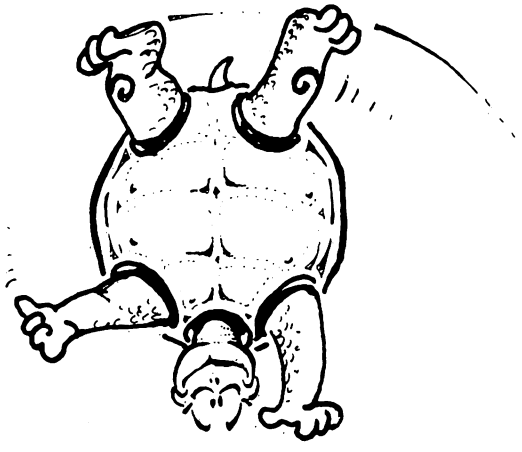
REPEAT 10 [FD 1 RT _____]

REPEAT _____ [FD 1 RT 4]

REPEAT 36 [FD 1 RT _____]

Have you figured out that if you multiply the REPEAT number by the RT number you'll get _____? That seems to be a very important number to the turtle.

What happens to the size of the circle as you change the amount the turtle turns each time? The more he turns (the higher the number), the _____ the circle.



There's another way to change the size of the circle. Choose one of the circle commands and this time try changing the FD number and keeping the other two numbers the same each time.

REPEAT 36 [FD ____ RT 10]

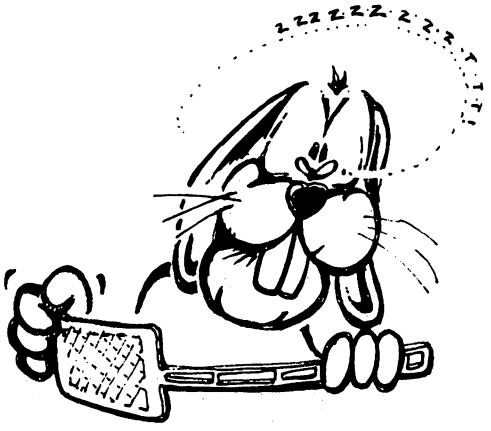
REPEAT 36 [FD ____ RT 10]

REPEAT 36 [FD ____ RT 10]

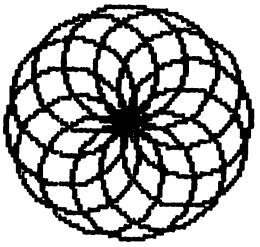
REPEAT 36 [FD ____ RT 10]

If you've tried all this experimenting, you're probably ready to try putting some circles together. Try some of these shapes or make up some of your own to try.

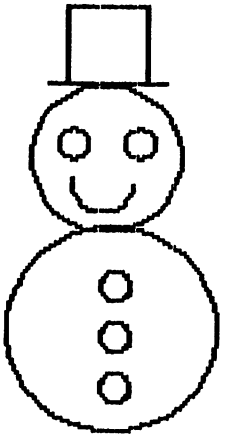
Eyes (**Hint** — You don't always have to turn right.)



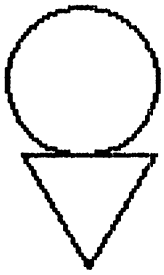
Flower



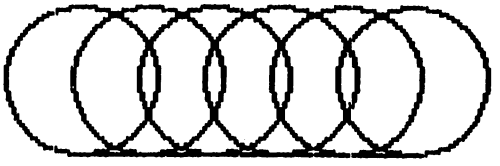
Snowman



Cone



Slinky

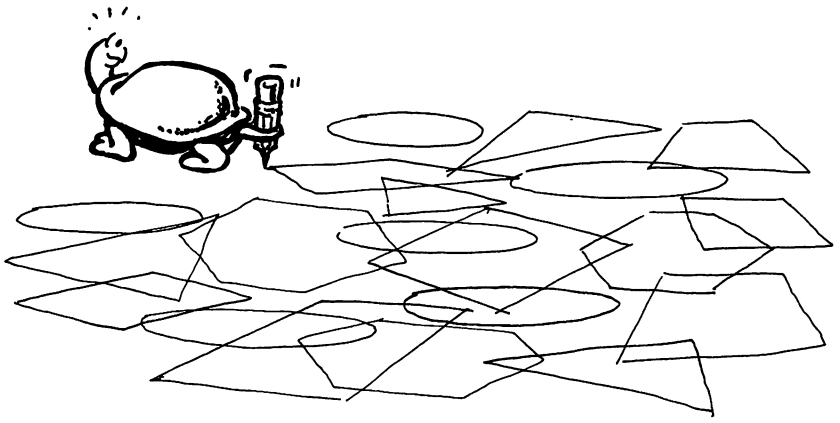


CHAPTER 3
VARIABLES

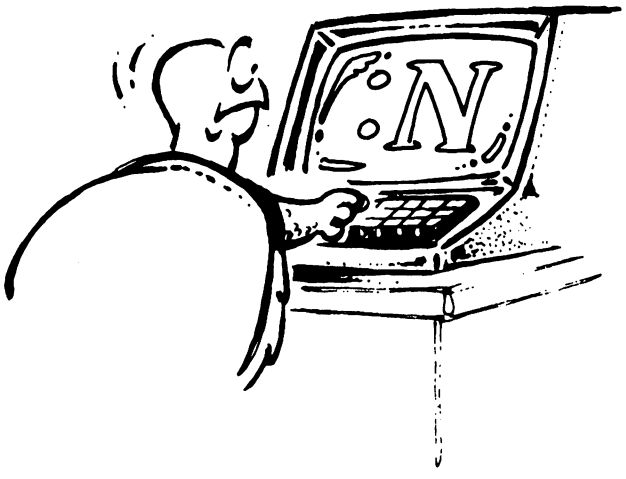
Three was a variable, Jack had so much fun.
He looked for a short-cut and, Wow! He found one!

USING VARIABLES

Our friendly turtle is always on the lookout for short-cuts. He really enjoyed making little boxes and big boxes and small circles and giant circles and little bitty triangles and medium-size ones. But it sure seemed like a lot of trouble to have to write a new procedure each time he wanted to draw a different size shape. He just knew there must be an easier way to do it.



Well, there is! It's called using a variable and here's how you do it. Instead of telling the turtle to go forward a certain number of steps, you tell him to go forward :N.

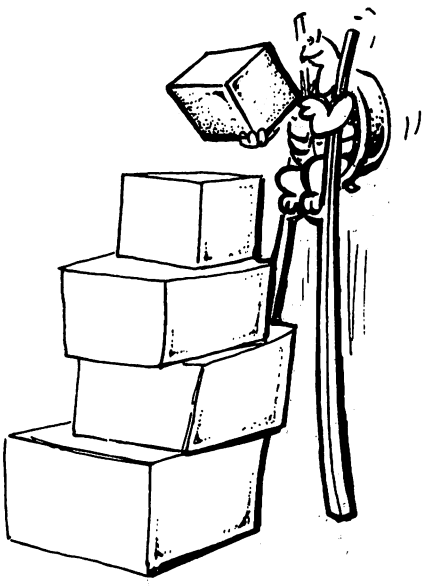


Yep! :N. "N" stands for number, and each time you give the turtle the command to draw a shape, you will be able to change the number without writing a whole new procedure. Here goes.

Type TO BOX :N and press RETURN. (The dots are found on the colon key, next to L.) Now type in the instructions for making a BOX only when you tell the turtle how far forward to go, use :N again. To leave the edit mode _____.

This is the way the procedure should look:

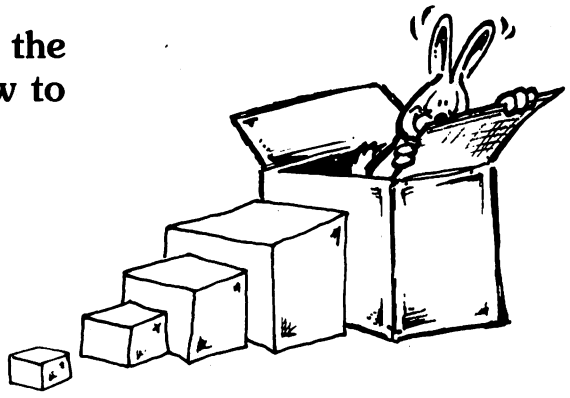
```
TO BOX :N
REPEAT 4[FD :N RT 90]
END
```



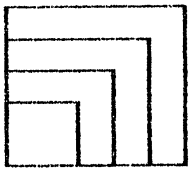
Great! You're all set to make any size BOX you want. Now the only tricky thing to remember is when you give the command BOX, you'll have to say what size BOX, like BOX 10 or BOX 27 or BOX 52 or whatever. If you forget to type in a number, you'll see the message

NOT ENOUGH INPUTS TO BOX

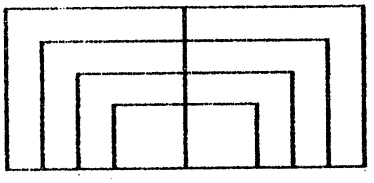
Using your new BOX procedure with the variable in it, can you tell the turtle how to draw these designs?



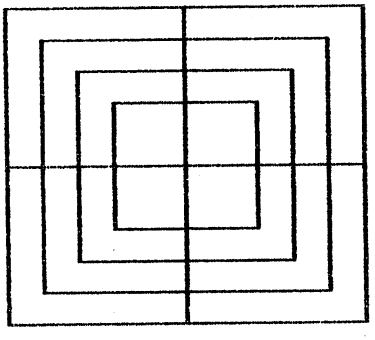
```
TO BOXES
BOX ____
BOX ____
BOX ____
BOX ____
END
```



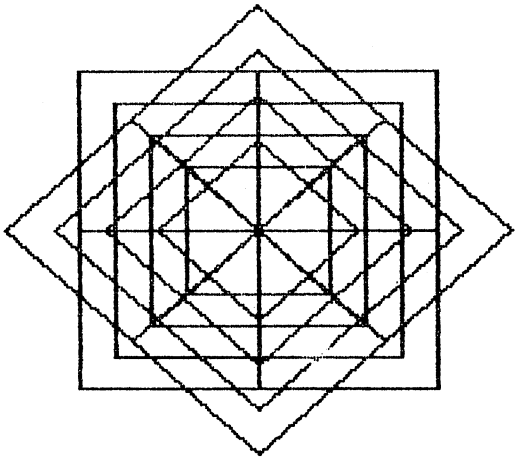
```
TO TABLES
BOXES
____ ____
BOXES
END
```



```
TO MIRROR
TABLES
____ ____
TABLES
END
```



```
TO MIRRORS
____ ____
____ ____
____ ____
END
```



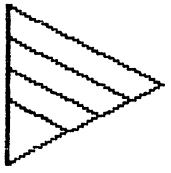
As you worked through these examples, did you notice that each new procedure used the one just before it as a command (or sub-procedure)? You could have defined MIRRORS by listing every BOX in the procedure. Wasn't it easier to define a small part of the design and then use it as a sub-procedure?!

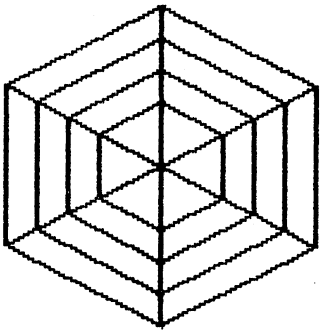
Also, do you realize we are developing our very own computer language? There's no other language I know of that has a "MIRRORS" command. You can be as original and as creative as you want. It's your language!

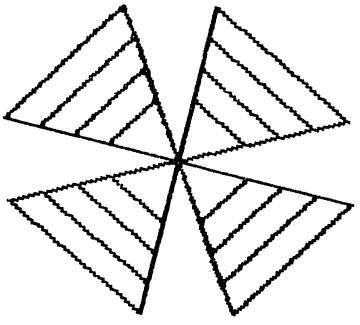
Can you write a triangle procedure with a variable?

```
TO TRI _____
REPEAT ___ [FD _____ RT _____]
END
```

Try some triangle designs using your new procedure:







OK, your turn! Here's lots of space to work with your triangle variables:

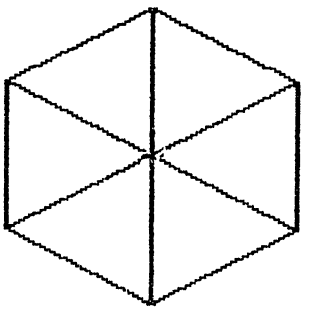
```
TO TRI _____
REPEAT ____ [FD _____ RT _____]
END
```

How many can you draw?

How many can you draw on the computer?

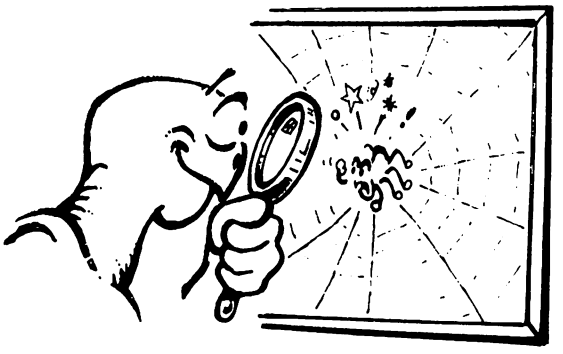
Here's a tricky thing you can do with variables. Use the procedure you just defined in a REPEAT command of another procedure like this:

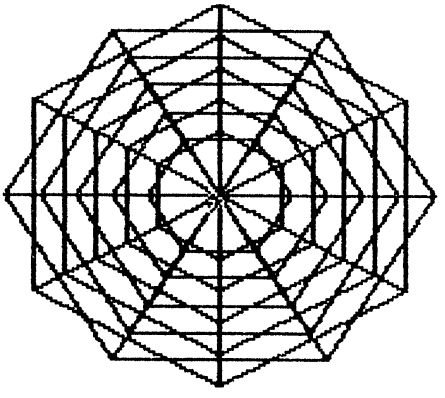
```
TO HEXAGON :N
REPEAT 6 [TRI :N RT 60]
END
```



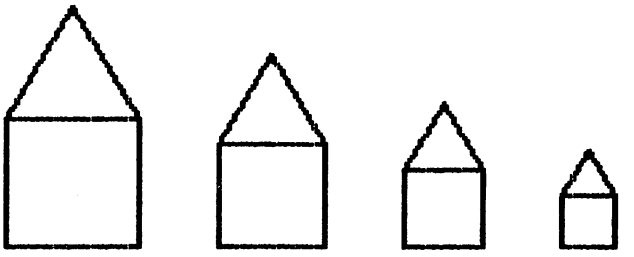
Now when you give the command HEXAGON, you'll have to tell the turtle how big to make each triangle within the procedure. Look at this spiderweb made out of HEXAGONs:

```
TO SPIDERWEB
HEXAGON 30
HEXAGON 40
HEXAGON 50
END
```





Hey! Remember the HOUSE procedure? Can you figure out how to edit HOUSE so you can make all different sizes of HOUSEs? If you can do it, run all the way around the block and tell every third person you see!



What could you add to the house procedure to make it more interesting?

Let's not forget the circle! Write a circle procedure with a variable:

TO CIRCLE _____

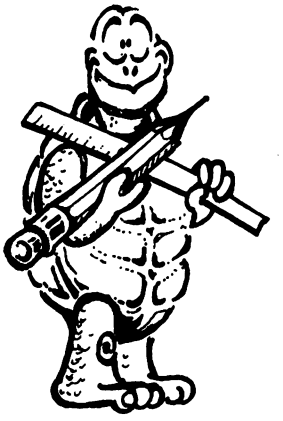
_____

END

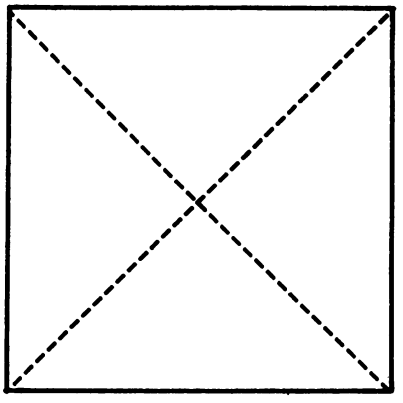
Hmmmm. What can you do with circles?

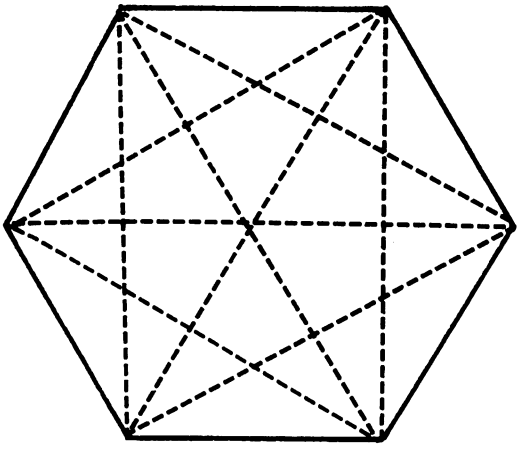
STARS AND PENTAGONS

After all that work, you deserve a great big STAR. Only thing is, though, you're going to have to figure out how to draw one!!!



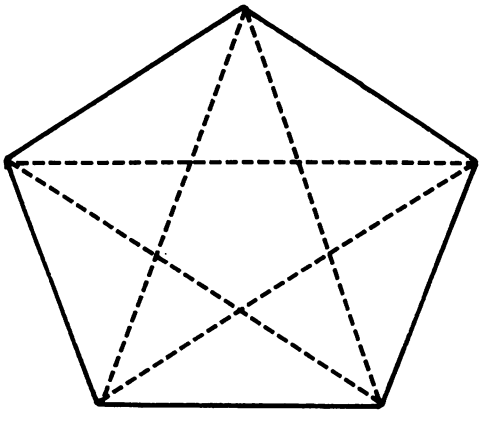
Get a sharp pencil and a ruler and let's design some stars! Did you know that if you draw diagonals on a pentagon (a figure with five equal sides), you'll make a perfect five-pointed star. A diagonal connects two corners of a figure like this:



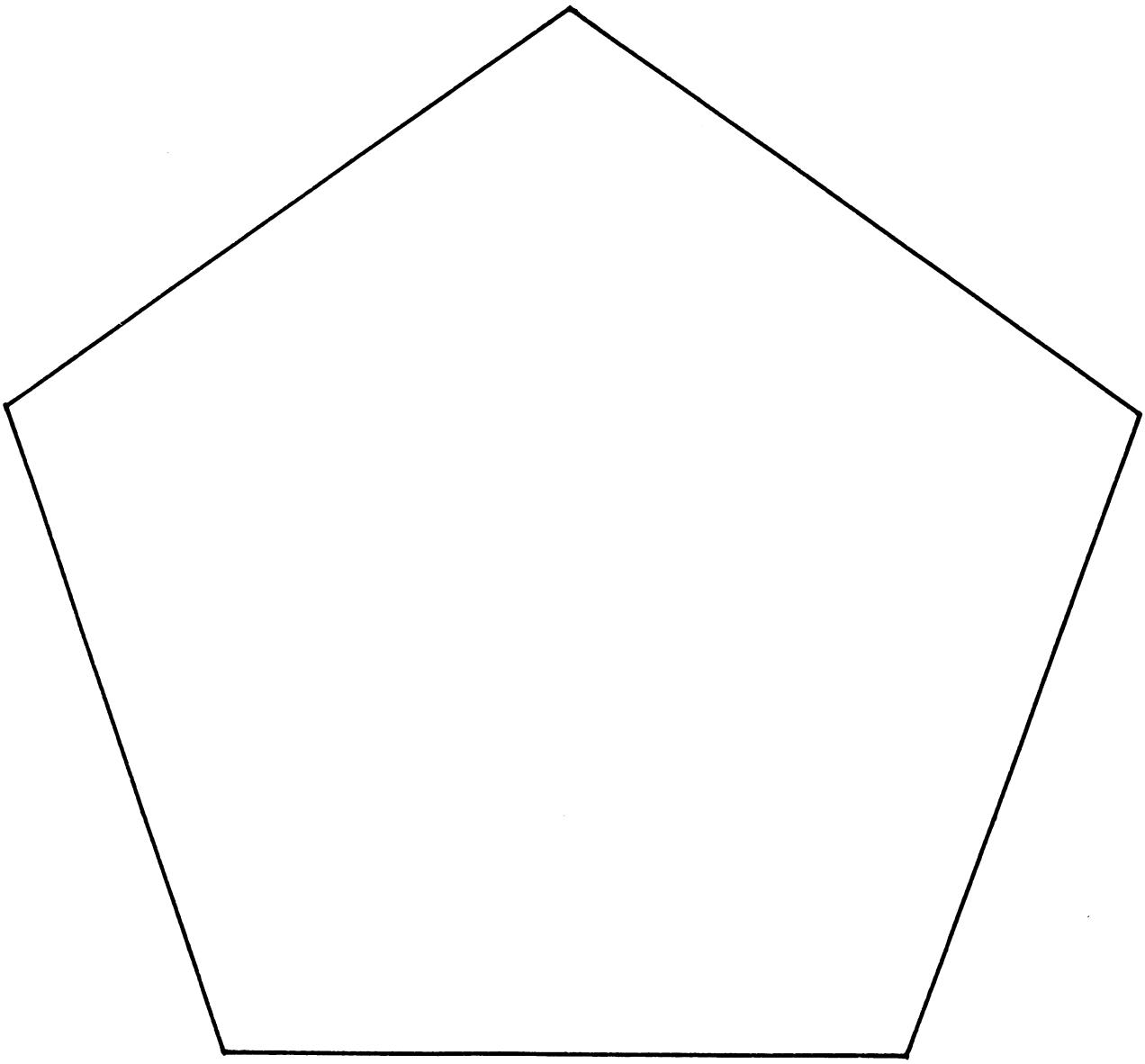


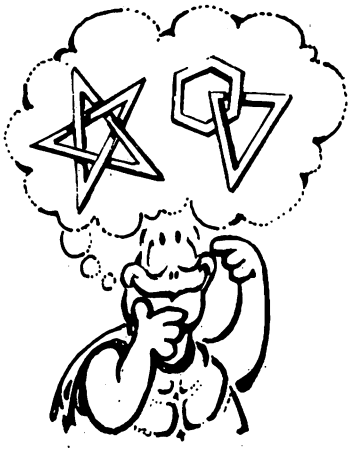
(The corners cannot be next to each other.)

Look at this pentagon. What happens when we draw the diagonals? Hey! Do you notice what's in the very center?
Another _____!



Here's a great big pentagon for you to play with. Draw the diagonals. Then when you see the smaller pentagon, draw its diagonals. How many times can you draw the diagonals until the figure gets too small to work with?





Now let's try to figure out how to get the turtle to draw a pentagon and a star.

This is another handy way to use variables - to help us figure out a missing piece of information. In this case, we know that both a pentagon and a star are drawn with five lines and each has five corners, right? So the turtle will have to REPEAT a forward command and a turn command five times. Since the size of the shape is up to us, we'll reach into a hat and pull out a number. I got 45. What did you get?

(Whoops, SIZE 7 won't work.
Pull out another one!)

So far, we have this much information:

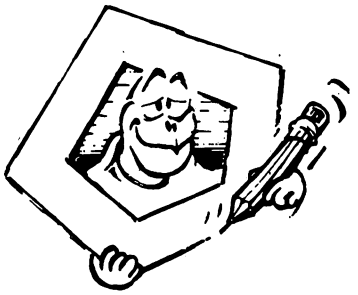
```
REPEAT 5 [FD 45 RT ____]
```

We could start playing around with that command until we found the right number. But since we already know how to use variables, we can save ourselves alot of typing by defining a procedure and then trying various numbers. Let's make it real easy to type. Let's call it PS (for pentagon and star).

```
TO PS :N
REPEAT 5 [FD 45 RT :N]
END
```

Now try lots of numbers and write down all the ones you try. Put a big red star beside the correct number for making a star and a pentagon beside the correct number for making a _____ — you got it!

I tried these numbers:



To make a STAR, the turtle must turn_____.

To make a PENTAGON, the turtle must turn_____.

Do you notice a relationship between these two numbers? (If you multiply _____ by _____, the answer is _____!)

When we first learned about variables, we used them to draw different sizes of the same shape. Now that you know how to draw a pentagon, can you write a procedure to draw any size pentagon you want? How about a star? You'll have to fill in the RT number and use the variable with the _____.

```
TO PENT____
REPEAT 5 [FD ____ RT ____]
END
```

```
TO STAR ____
REPEAT 5 [FD ____ RT ____]
END
```

Can you fill the screen with stars? Hey! Can you draw the Big Dipper?

Here's some space to doodle with stars and pentagons (and you can always include triangles, squares, and circles). Golly, we can draw just about anything now!

In fact, why not make a procedure to draw any shape? It will have to REPEAT the number of sides the shape will have. Then it will have to go FORWARD the distance you want each side to be. And, it will have to turn the correct angle to make the shape with the number of sides you asked for in the REPEAT statement.

Whoa! This is getting complicated! Let's think this through some more.

```
TO ANYSHAPE  :R  :D
REPEAT  :R [FD  :D RT_____]
END
```

What are we going to put after RT? If we want a square it would be 90, and :R would be 4, right? What about a triangle? Wouldn't that be REPEAT 3 and RT 120? If we want a pentagon, it would be REPEAT 5 and RT 72. What would you put in the procedure to make a circle? To make a circle, :R would be 360 and RT would be 1, wouldn't it? Now, what do all of these angles and REPEAT commands have in common?

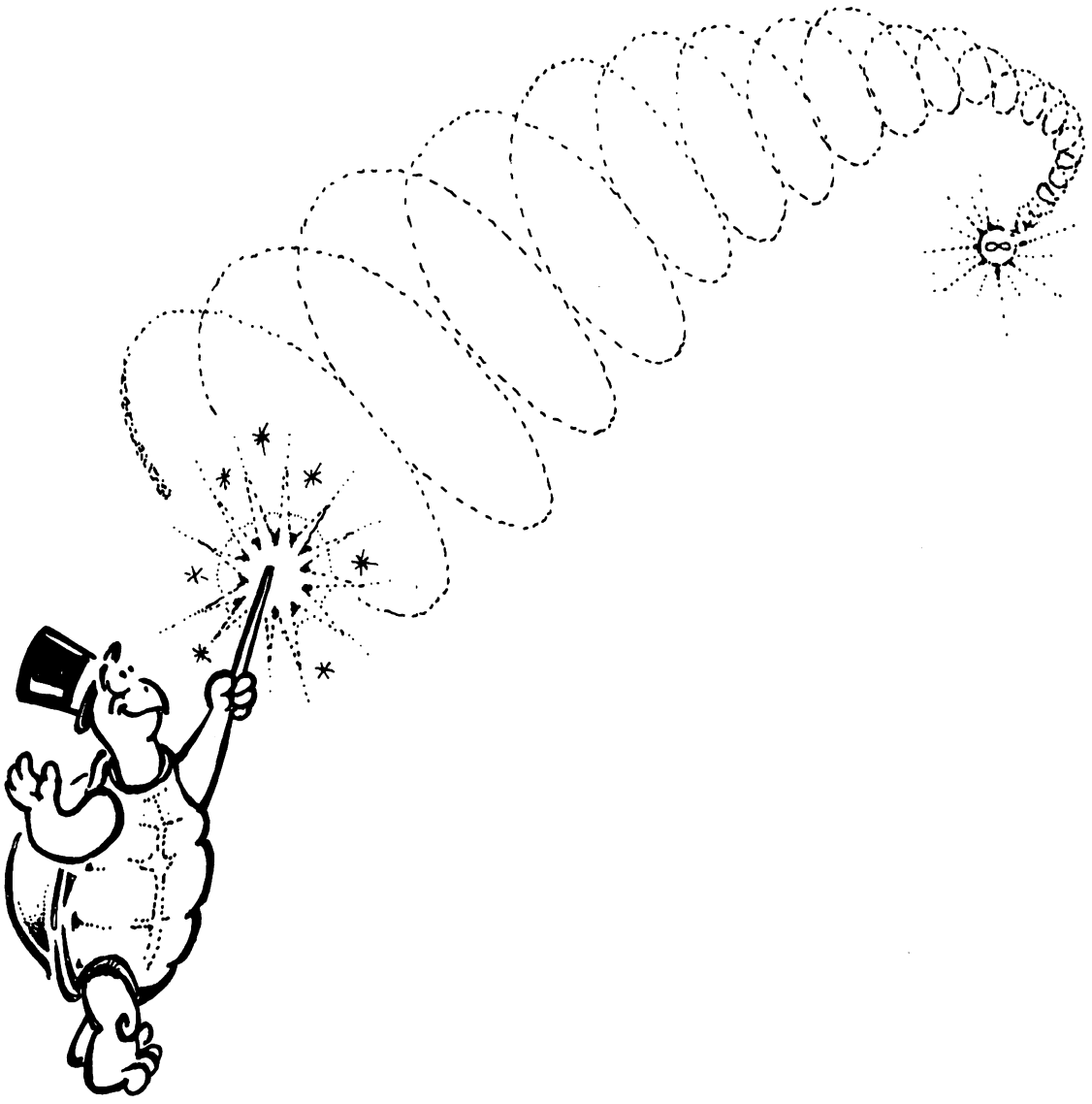
To make a triangle, you use REPEAT 3 and RT 120, or 360/3. The square is made by REPEAT 4 and RT 90, or 360/4. The pentagon is made with REPEAT 5 and RT 72, or 360/5. What do you use for a hexagon?

Now let's add to the ANYSHAPE procedure.

```
TO ANYSHAPE  :R  :D
REPEAT  :R [FD  :D RT 360/:R]
END
```

Now you really can draw just about any shape you want. Go ahead and try it. Isn't it fun to experiment?

CHAPTER 4
RECURSION



Four was recursion so magically clever.
Danielle made a spiral that goes on forever.

PROCEDURES THAT USE THEMSELVES

A recursive procedure is one that uses itself. Huh? Well, it's kind of like looking into a mirror with another mirror behind you. How many of you do you see? It seems as if you go on forever!

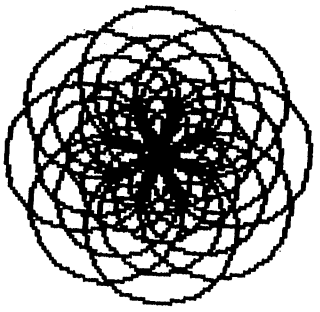
Why don't you go take a look?

The first image that you see is backward. Then it returns to normal in the second image. The next is backward and the next is normal. Make a sign and hold it up to the mirrors. See how the words are backward and then they return to read correctly.

This is a recurring pattern. It seems to go on forever. But how did that crazy rabbit get into our mirror?

One the computer, recursion seems almost magical. It gives you the chance to do all sorts of things over and over again. But this is a lot more than just repeating a procedure a number of times. Let's start a simple procedure that will keep repeating itself until your Mom calls you to dinner! Look at SPAGHETTI for example:

```
TO SPAGHETTI
CIRCLE 5
CIRCLE 4
CIRCLE 3
CIRCLE 2
RT 45
SPAGHETTI
END
```

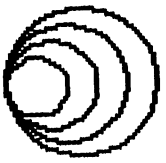


CIRCLE was defined with a variable like this:

```
TO CIRCLE :N
REPEAT 36 [FD :N RT 10]
END
```

After the turtle draws four circles, he will turn RT 45. Is that SPAGHETTI? Well, yes and no. Here's what it looks:

```
CIRCLE 5
CIRCLE 4
CIRCLE 3
CIRCLE 2
RT 45
```



That hardly looks like any spaghetti I've ever eaten. But if we could somehow get the turtle to use the procedure over and over, it might look a little more appetizing. So we use a recursive line to tell the turtle to do just that. When he reads the next line telling him to do the procedure called SPAGHETTI, guess what he does — SPAGHETTI! (CIRCLE 5, CIRCLE 4,CIRCLE 3, CIRCLE 2 and RT 45.) Every time he gets down to the spaghetti line, he does SPAGHETTI. And he'll do it over again and again and again until you stop him with:

Now look back at some of the procedures you've defined and pick out a couple you can change to include a spaghetti line — I mean a recursive line. (Recursion reminds me of spaghetti because it's kind of hard to get a handle on. Once you do, though, there's nothing like it!)

Here are a couple of procedures the turtle came up with:

Remember those flower procedures we did? You can make them recursive.

```
TO FLOWER :N
SQUARE :N
RT 20
FLOWER :N
END
```

Notice how using the variable will allow you to draw any size flower you want! Be sure to use :N again in the recursive line.

Here is a procedure to draw a sun with triangles:

```
TO SUN
TRIANGLE 20
RT 60 FD 20 LT 30
SUN
END
```

Suppose you want to draw various sizes of suns. Just edit the procedure to include a variable:

```
TO SUN :N
TRIANGLE :N
RT 60 FD :N LT 30
SUN :N
END
```

The designs we've drawn so far could have been drawn using a REPEAT command, only the turtle would have quit after he'd repeated the commands the number of times you told him to. In the color chapter, we'll add a changing color to the procedure so you can see that the turtle doesn't quit once he's drawn the design. He really does keep going. In the meantime, let's experiment some more.

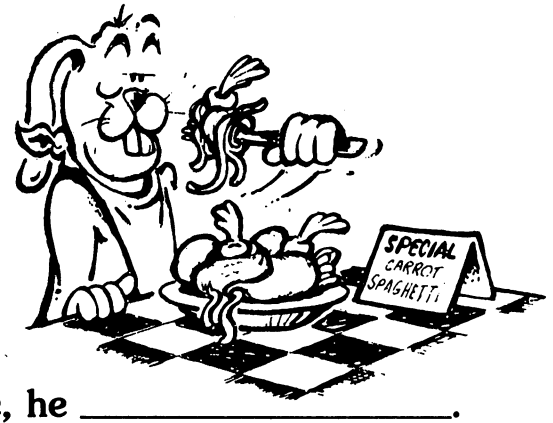
Try turning RT 27 on the FLOWER procedure. What happens?

What can you do with the HOUSE procedure? Can you figure out how to write a recursive procedure to draw a suburb?

Write at least three recursive procedures of your own:

Do you like recursion?

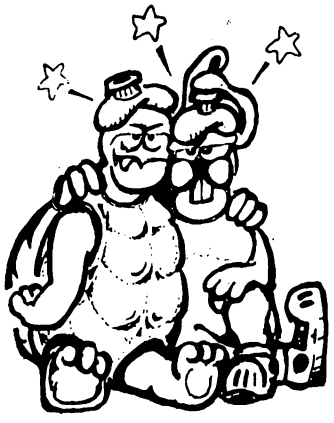
A. Yes
B. No
C. I'm not sure yet
D. I'd rather have spaghetti



When the turtle "reads" a recursive line, he _____.

To stop a recursive procedure, press _____ _____.

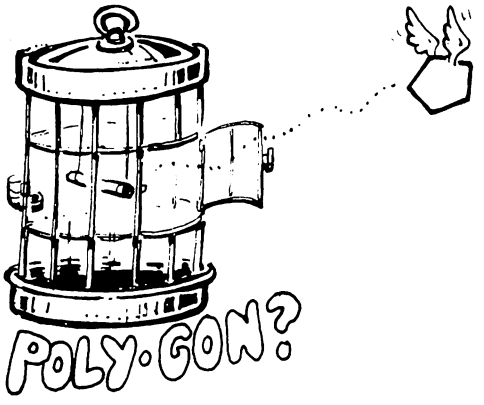
Here is a recursive procedure with TWO variables. This is the first time we've used two variables in the same procedure. Instead of using :N for both of them, we'll have to use two different letters or the turtle will get very confused. (And the poor rabbit will never be the same.)



Let's use :A for the RT variable and :S for the FD variable. (A can stand for angle and S for side.)

```
TO POLYGON :S :A
FD :S
RT :A
POLYGON :S :A
END
```

When you give the command POLYGON, you'll have to type two numbers: one to tell the turtle how far to go forward on each side and one to tell him how much to turn. Try lots of numbers and write them down. Draw a sketch of what happens on the screen.



If you tried lots and lots of numbers you might have figured out that you can draw just about any shape you want with this one procedure!

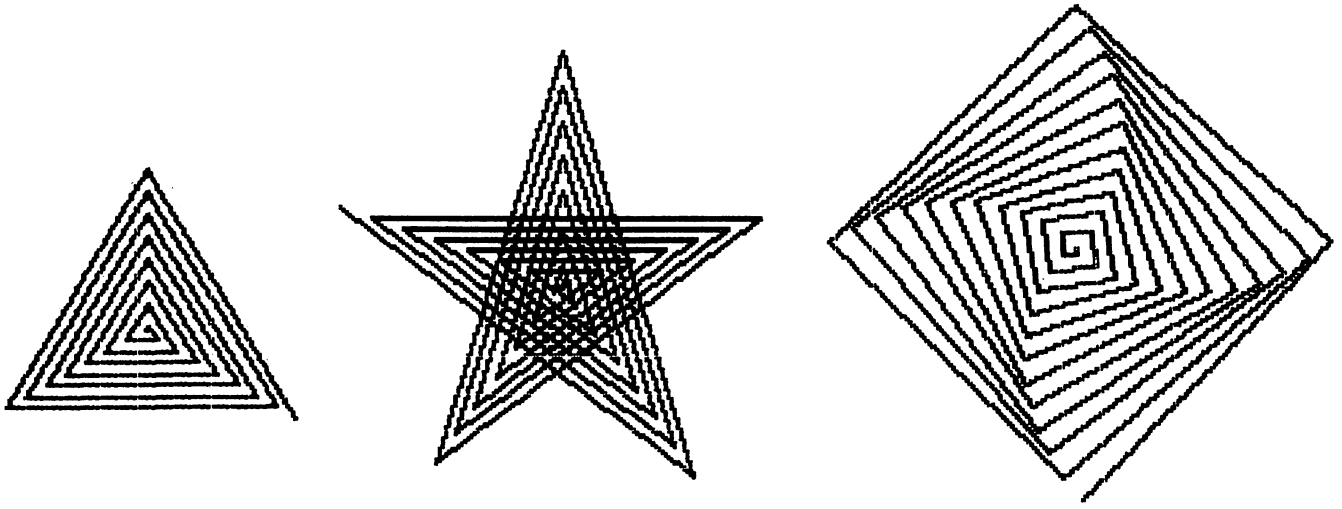
Now do you like recursion?

A. I already said yes.
B. Yes.
C. Ok, Rabbit, what'd you do with the sauce?

SPIRALS

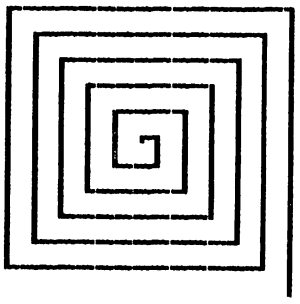
Sometimes it's fun to send the turtle on a spiral walk, around and around and around until he gets dizzy.

First, can you draw some spirals? Use colored pencils or crayons if you want so they'll be real colorful.



They're so much fun to draw, you might like to experiment with drawing different kinds of shapes, but right now, let's let the turtle have some fun, too.

Did you notice that when you were drawing a spiral, each side got just a little longer than the one before it? It's especially easy to see this on the square spiral. If the first line had a length of one turtle step, the second might be two turtle steps, the third might be three, etc. Each time the turtle draws a side, he'll have to add at least one more step. You can add five each time or three or any number you like.



Try this:

```
FD 5
RT 90
FD 6
RT 90
FD 7
RT 90
FD 8
```

You could keep going all day, but by now you're probably trying to figure out if there isn't a short-cut. You're right again — there is! And it's another procedure that uses a variable and recursion.

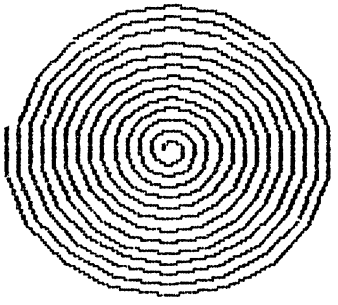
Try this:

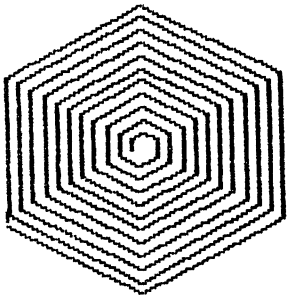
```
TO SPIRAL :N
FD :N
RT 90
SPIRAL :N + 1
END
```

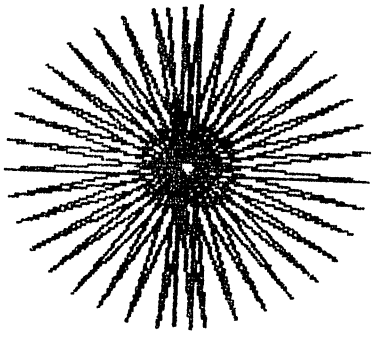
Look at the recursive line. This time, it not only tells the Turtle to do the procedure over but it also tells him to add 1 to the value of N. For example, if you give the command SPIRAL 12, the first FD command will tell the Turtle to go forward 12 steps. Then he'll turn 90. The next line tells him to go back to the top line and add one to the value of N. Now he'll have to go forward 13 steps. Each time he gets to the fourth line, he'll go back to the first command and add one more step to the distance he'll have to travel.

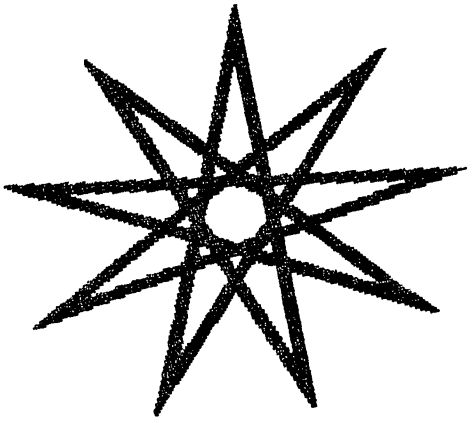
If you haven't tried it yet, do it now. It's one of those things you have to see to believe!

The Turtle is crazy about spirals, so try some different kinds. Try changing the RT turn. Try 89 or 144. Try changing the number in the fourth line to 3 or 5 or whatever.









What if you start with a high number for the value of N and in the fourth line you have the Turtle subtract 1 instead of add 1???

Try this:

```
TO SUPERSPIRAL :N
FD :N
RT 88
SUPERSPIRAL :N - 2
END
```

Remember SPAGHETTI? (How could you forget it?) Well, try this!

```
TO SPAGHETTI :N
CIRCLE :N
RT 15
SPAGHETTI :N +1
END
```

Wow! Spiral SPAGHETTI!!!

This is just a taste of what Recursion can do. It seems a lot like Loops in other languages. (They call that iteration, or repetition. But enough of those big words.)

Some friends sent us a great puzzle to show what recursion can do. Can you tell the difference between these two procedures? Can you draw what each will do before you run them on the computer?

```
TO MAZE  :N
IF  :N > 120 [STOP]
FD  :N
RT 90
MAZE  :N + 2
END
```

```
TO AMAZE  :N
IF  :N > 120 [STOP]
AMAZE  :N + 2
FD  :N
RT 90
END
```

CHAPTER 5
COLORS, COLORS, COLORS

Five was a pocket of colors so bright.
Chad began drawing and stayed up all night.

In addition to having a yellow turtle drawing with a yellow pen on a blue background, the turtle keeps several other colors in his pocket just in case you want them. In fact, he has 16 colors with 8 shades of each one. That makes 128 colors in all.

Each one has a number. Here are all the colors he has.

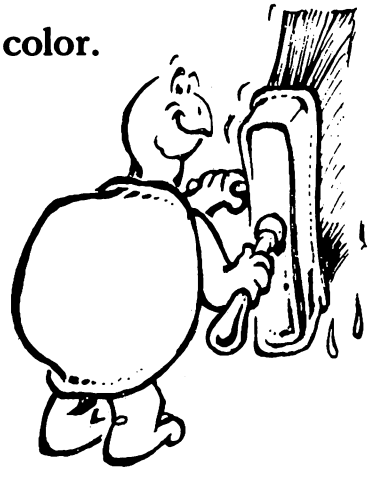
0 -7	GRAY
8 - 15	LIGHT ORANGE
16 - 23	ORANGE
24 - 31	RED-ORANGE
32 - 39	PINK
40 - 47	PURPLE
48 - 55	PURPLE-BLUE
56 - 63	BLUE
64 - 71	BLUE
72 - 79	LIGHT BLUE
80 - 87	TURQUOISE
88 - 95	GREEN-BLUE
96 - 103	GREEN
104 - 111	YELLOW GREEN
112 - 119	ORANGE-GREEN
120 - 127	LIGHT ORANGE

The low number is the darker shade of the color. The higher number is the lighter shade. The color numbered 64, for example, is a dark blue, and the color numbered 71 is a very light blue.

You can change the color of the background, the color of the turtle's pen, and the color of the turtle himself. So, c'mon. Let's experiment.

First try changing the background color:

Type SETBG and the number of the color.



How would you like to try a recursive procedure that cycles through some colors? We'll use a WAIT command so the screen will stay one color for awhile and then turn to another color. Since we're using WAIT 50, it's kind of like telling the computer to count to 50 before it reads the next command.

```
TO RAINBOW
SETBG 0
WAIT 50
SETBG 10
WAIT 50
SETBG 20
WAIT 50
SETBG 30
WAIT
SETBG 40
WAIT 50
SETBG 50
WAIT 50
SETBG 60
WAIT 50
SETBG 70
WAIT 50
SETBG 80
WAIT 50
SETBG 90
WAIT 50
SETBG 100
WAIT 50
SETBG 110
WAIT 50
SETBG 120
WAIT 50
RAINBOW
END
```

After the turtle defined a RAINBOW he realized he was typing the same things over and over with only the number of the color changing. He wondered if he could define a procedure using a changing variable like he did with the spiral. So he tried this:

```
TO RAINBOW  :C
SETBG  :C
WAIT 50
RAINBOW  :C + 1
END
```

Uh oh! What happened? It says that SETBG doesn't like 128 as input in RAINBOW.

We'll have to add some kind of a statement to make the computer start over if it gets to 127. Here's what the turtle came up with:

```
IF  :C  >  127 [MAKE "C 0]
```

Let's take a good look at this now. What the turtle is telling the computer is that IF the value of C is greater than 127, THEN do what is inside the brackets. In this case, MAKE the value of C equal to 0.

That little arrow means "greater than." The point of the arrow always points to the smaller of the two things being compared. On the keyboard, you'll see another little arrow pointing the other way. What do you think that means? If you said "less than," give yourself three Gold Stars. That's pretty good!!!

Here's how the procedures look with the IF-THEN command included:

```
TO RAINBOW  :C
IF  :C > 127 [MAKE "C 0]
SETBG  :C
WAIT 50
RAINBOW  :C + 1
END
```

Everytime the computer reads an IF-THEN statement, it tests the first part to see if it is true. If it is, it then does what is inside the brackets. If it is not true, it just skips the brackets and goes on about its business.

Let's write this procedure another way, to make it do something else.

```
TO RAINBOW  :C
IF  :C > 127 [STOP]
SETBG  :C
WAIT 50
RAINBOW  :C + 1
END
```

What do you think will happen now? Why not try it and see!!!

Now let's try changing the pen color.

You used SETBG to change the BackGround color. So what do you think the command would be to change the Pen Color?

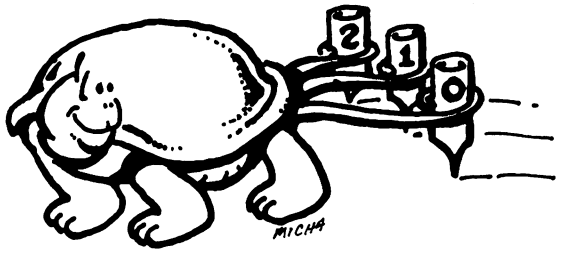
You got it! SETPC.

Here's a procedure which will let you try all sorts of things using different pen colors, different distances, and different angles.

```
TO TRAIL  :C  :D  :A
IF  :C  > 127 [MAKE "C 0]
SETPC 0  :C
FORWARD  :D
RIGHT  :A
TRAIL  :C + 1  :D + 5  :A
END
```

Whoops! What is that 0 in between SETPC and the color variable?

A lot of other LOGO turtles have pens which can draw in different colors. But did you know that the Atari LOGO turtle has three pens. And each of these pens can draw in a different color! Of course, these three pens can not draw at the same time, but they do give you the chance to have turtle drawings in three different colors.



The pens are numbered 0, 1, and 2. If you want to find out which pen the turtle is using, just type in:

```
PRINT PN
```

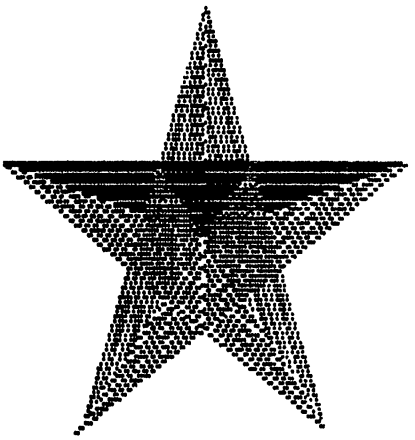
If you want to change from one pen to another, what command do you use?

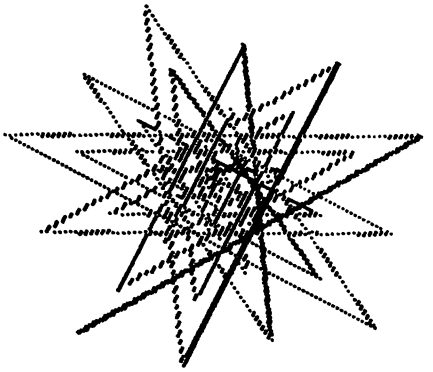
This is getting easy now, isn't it? You use SETPN, of course.

This is a lot to think about all at once. And so, let's see what the differences are. First, let's run the TRAIL procedure. Type in TRAIL followed by the number for a color, a number for the distance the turtle is to travel, and a number for the angle the turtle is to turn. Try typing with these numbers and then experiment with some of your own.

```
TRAIL 5 10 72
TRAIL 0 20 100
```

What happened?





That was pretty good, wasn't it?

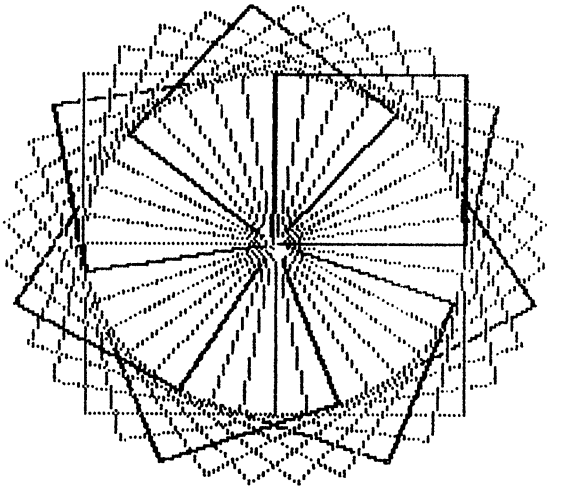
Well, how about trying a few more tricks? Let's see what you can do with different pens and different pen colors.

Do you remember the ANYSHAPE procedure?

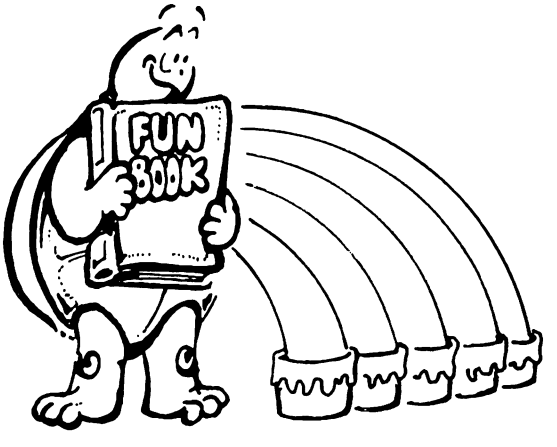
```
TO ANYSHAPE  :R  :D
REPEAT  :R [FORWARD  :D RIGHT 360 /  :R]
END
```

Now let's change the colors.

```
TO CHANGE.COLORS  :R  :D  :C
SETPN 0
SETPC 0  :C
ANYSHAPE  :R  :D
RIGHT 360 /  :R + 10
SETPN 1
SETPC 1  :C + 10
ANYSHAPE  :R  :D
RIGHT 360 /  :R + 10
SETPN 2
SETPC 2  :C + 20
ANYSHAPE  :R  :D
END
```



Do you know what the Turtle did when they discovered they had all of these beautiful colors to play with? He went back through this FUN-BOOK and did all of the designs all over again in his favorite colors. Then he tried mixing colors; doing one design, then changing pencolor, and doing it again on another part of the screen.



Turtle went back to the Recursion chapter and had a great time adding color to some of those procedures. Here's how he made a SUN:

```
TO TRIANGLE  :N
REPEAT 3 [FORWARD  :N RIGHT 120]
END


TO SUN  :N  :C
IF  :C  >  127 [MAKE "C 0]
SETPC 0  :C
TRIANGLE  :N
RIGHT 60 FD  :N LT 30
SUN  :N  :C + 1
END
```

What else can you do with colors? What about drawing with different pens in different colors?

Wouldn't it be nice to fill in the shapes with colors? But there is no FILL command in Atari LOGO.

Why not make one!

The first thing we'll need is the ANYSHAPE procedure. How can we add to that to make a FILL command?

```
TO ANYSHAPE  :R  :D
REPEAT  :R [FD  :D RT 360/:R]
END
```

In the chapter on recursion, we talked about adding and subtracting from variables to change the shapes drawn on the screen. Well, why not get some graph paper and do some experimenting. Draw a square with each being :D steps long. How long was your :D? Mine was 20.

Now draw the square with :D – 1 on each side. If you keep that up, what happens? Try it on the computer.

Now we can change ANYSHAPE to FILL and add a couple of more lines.

```
TO FILL  :R  :D
IF  :D = 0 [STOP]
REPEAT :R [FD  :D RT 360/:R]
FILL  :R  :D - 1
END
```

Go ahead and try this out with a few different shapes. It works fine with triangles, squares, pentagons, and hexagons. When you get to shapes with more than six sides, you may find that gaps appear. See what happens when you write the recursive line like this?

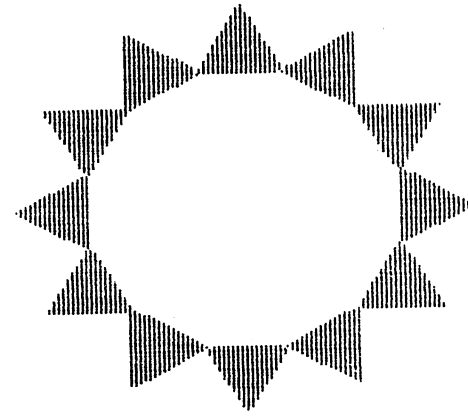
```
FILL  :R  :D - .5
```

Now let's go back and change the sun procedure and see what happens when FILL is added.

```
TO SUN  :R  :D  :C
IF  :C  > 127 [MAKE "C 0]
SETPC 0  :C
FILL  :R  :D
RT 60 FD  :D LT 30
SUN  :R  :D  :C + 1
END
```

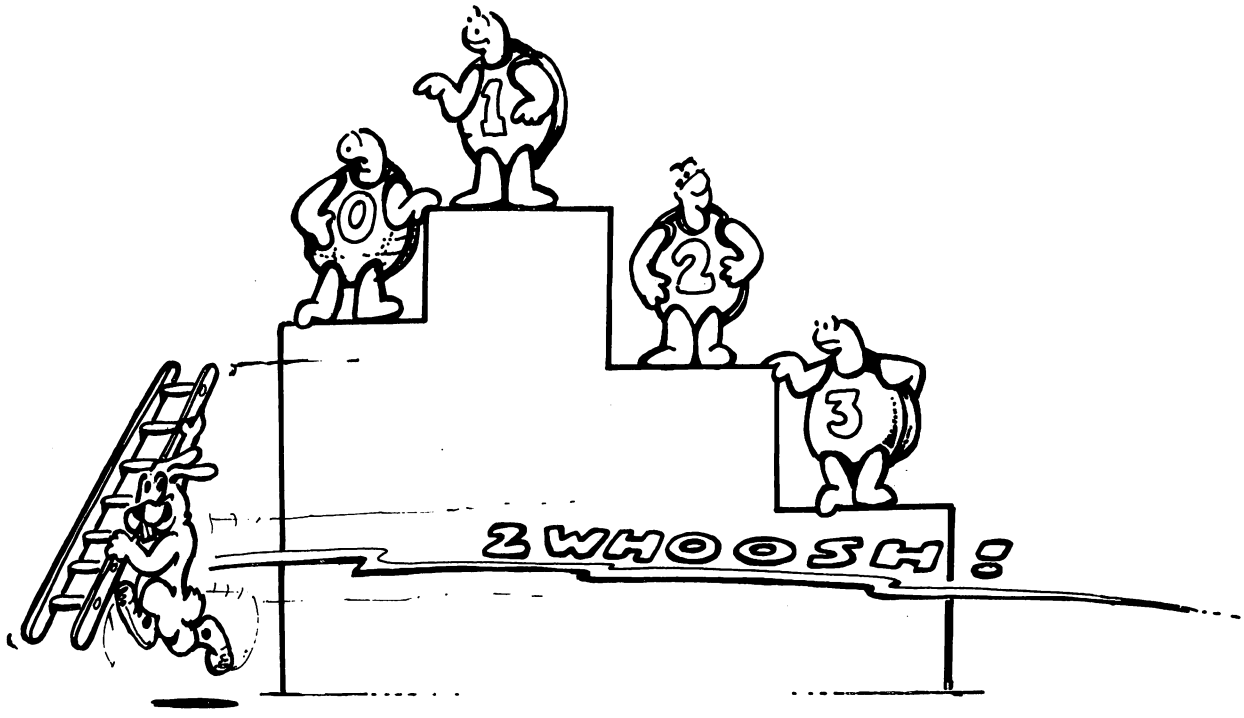
This procedure gives us a Sun with changing colors. Can you make a multi-colored Sun?

Aw, C'mon! Bet you can. Try it!



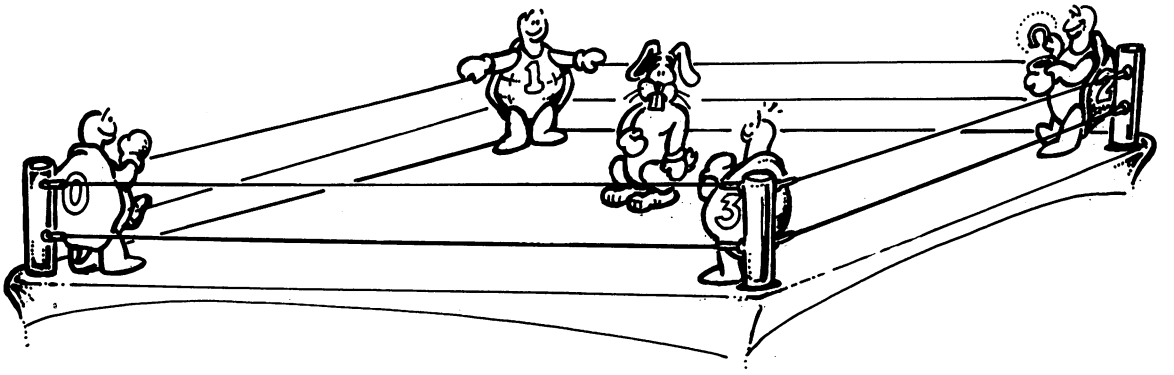
What about changing the color of the turtle? To find out more about that, turn to Chapter 6.

CHAPTER 6
MULTIPLE TURTLES



Six is a lot, really more than I've got,
How about four for a crew? They'll find lots to do!

MULTIPLE TURTLES



What did the turtle say? Did he say four turtles?

Look on the cover of your FUNBOOK. There's the rabbit trying to help the turtle crew get off the ground.

How many turtles do you see?

Four? That is just how many you have to work with in Atari LOGO. You can talk to any one of the turtles, any two or three, or you can talk to all four at once.

How about that!

Each of the turtles can do all sorts of things. We'll give you a taste of what you can do with four turtles. Then why don't you go off and explore on your own.

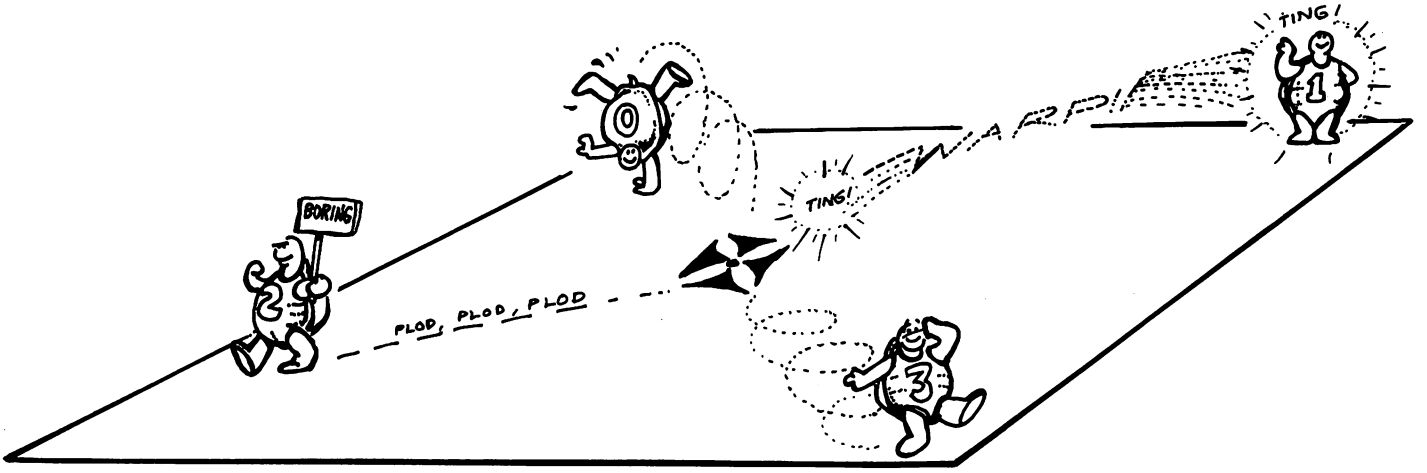
You're getting pretty good at that by now.

Think you can handle four turtles?

Let's give it a try.

You talk to each Atari LOGO turtle by its number, 0, 1, 2, or 3. And when you talk to each, you TELL each what to do.

```
TELL 0 FORWARD 50
TELL 1 RIGHT 90 FORWARD 50
TELL 2 RIGHT 180 FORWARD 50
TELL 3 LEFT 90 FORWARD 50
```



Now you're looking at four turtles. If any of these don't appear, enter ST and you'll see him. Now clear the screen with CS.

What happened?

All of the lines disappeared and the blue turtle, 3, came back home. What about the other ones? Here's how to bring them back home.

```
TELL [0 1 2] CS
```

Now type in FORWARD 50. Who moved? Who didn't move? Why?

Turtle 3, the blue one, stayed home. That's because you weren't talking to him any more. You were still telling 0, 1, and 2 what to do. So now, type in CS again to bring all of the Turtles home again.

Now let's try this.

```
TELL [0 1 2 3] PENUP
```

All four turtles now have their pens up. The next thing to do is spread them out so we can see what they're doing.

```
TELL 0 LEFT 90 FORWARD 60 RIGHT 90
TELL 1 LEFT 90 FORWARD 20 RIGHT 90
TELL 2 RIGHT 90 FORWARD 20 LEFT 90
TELL 3 RIGHT 90 FORWARD 60 LEFT 90
```

Do you want to change the color of the turtles? That's easy. All you need to do is use the SETC command. Try this:

```
TELL [0 1 2 3] SETC 72
```

What happened? Can you change the color of just Turtle 3? What about changing the color of both 1 and 2?

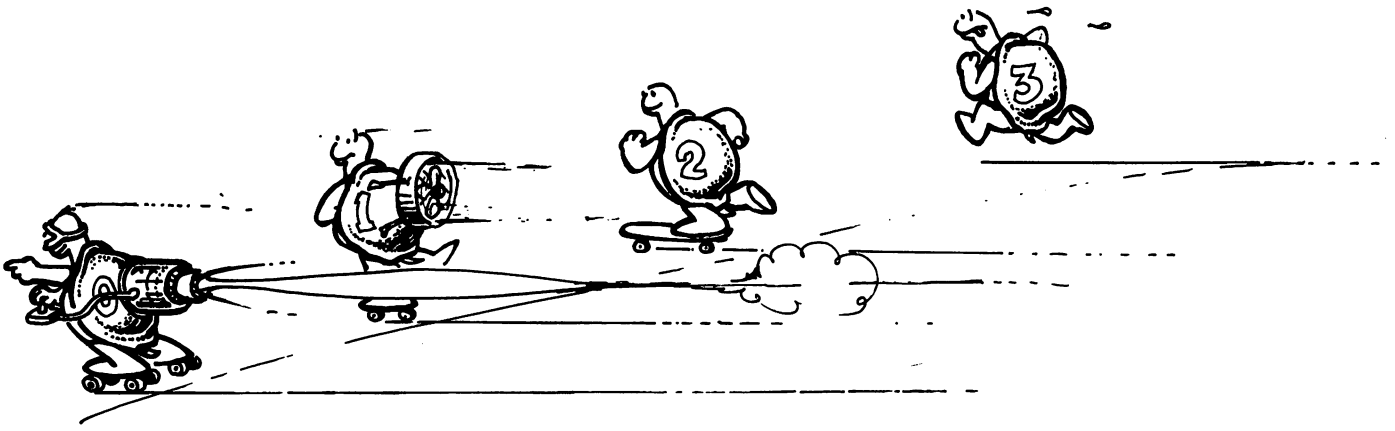
Go ahead. Experiment some more.

Now let's try something really different! All of those turtles are lined up like they are about to start a race. Well, let's set a speed for them to run.

Type TELL [0 1 2 3] SETSP 30

You can set the speed to any number from −199 to 199. You can even set speeds in decimals if you want.

Go ahead. Experiment! Try all sorts of numbers and watch the turtles speed up and slow down. Type in a minus number, like SETSP −100, and watch the turtles go in reverse.



Now, how about a race. You're going to use a RANDOM command which asks the computer to pick a number for you.

RANDOM is like picking a number out of a hat when you're blindfolded. You'll never know what that number is going to be until you read it off the card. Of course, to pick a number from a hat, you have to put numbers in it. In LOGO, you have to tell the computer how many numbers to pick from. You do this by typing RANDOM with a number after it. RANDOM 2 means pick either 0 or 1. RANDOM 4 means pick 0, 1, 2 or 3.

What does RANDOM 100 mean?

How could you get the computer to pick a number between 1 and 5? Between 10 and 15?

If you said RANDOM 5 + 1 and RANDOM 5 + 10, give yourself a Gold Star.

Now let's race.

```
TO RACE  :TIME
SET.UP
TELL [0 1 2 3] SETSP 20
RUN.RACE  :TIME
END

TO SET.UP
TELL [0 1 2 3] PENUP
TELL 0 LT 90 FD 60 RT 90
TELL 1 LT 90 FD 20 RT 90
TELL 2 RT 90 FD 20 LT 90
TELL 3 RT 90 FD 60 LT 90
FS
END

TO RUN.RACE  :TIME
IF  :TIME = 0 [WAIT 300 SETSP 0 STOP]
ASK RANDOM 4 [SETSP RANDOM 100]
RUN.RACE  :TIME - 1
END
```

Enter RACE and a number; for example, RACE 8. The SET.UP procedure sets up the screen by placing the turtles on a line. Then the rest of the screen is cleared by the FS command (Fullscreen).

All four turtles start out at SETSP 20. Then the real racing starts.

In the RUN.RACE procedure, you'll find another new command, ASK. The procedure asks the computer to pick one of the four turtles at random. Once it knows which turtle it is talking to, it asks that turtle to pick a speed between 0 and 100.

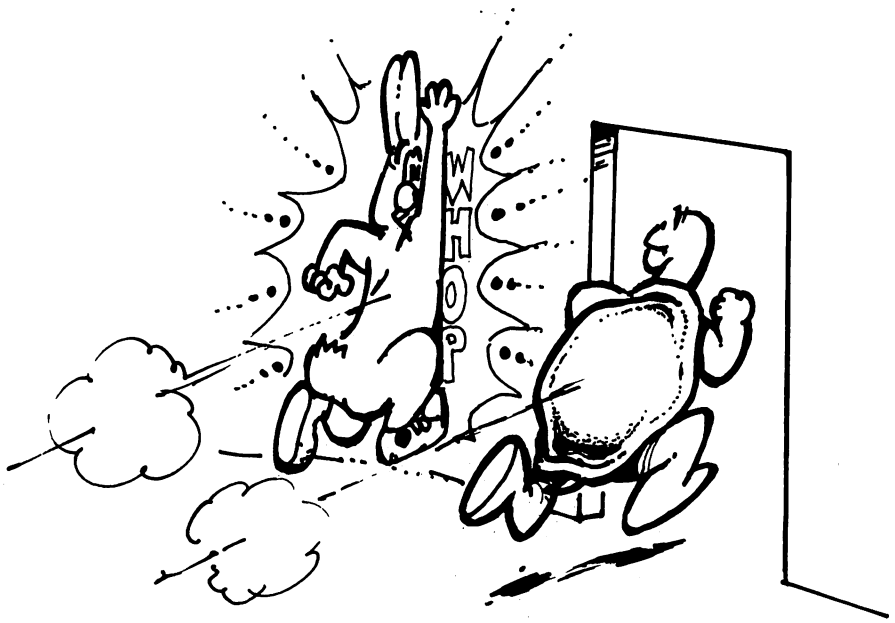
Finally, it says subtract 1 from the value of TIME and then go back and do the same thing again. When TIME equals 0, the computer counts of 300, sets the speed of all of the turtles to 0, and then stops the procedure. You can tell which turtle won the race.

Did you have trouble keeping track of the racers?

What happened?

There wasn't a finish line there. And it wasn't very easy to keep track of who was winning, was it? Well, this race was only to get you started on some of the things you can do with four turtles. Why don't you make up your own race?

One of the features of Atari LOGO you can use for your race is "collision detection."



There are lots of different things you can do with Collision Detection. You can ask the computer to detect when two turtles collide. You can also ask when one or more turtles cross a line drawn by pen #0 or another pen.

In fact, we could just about write another book on all of the things you can do with Collision Detection. Maybe we'll do that someday. But right now, let's get a taste of what you can do with this feature.

Let's go back to our race and make it easier to understand.

The first thing we have to do is set up the screen for our race.

```
TO SET.UP
VANISH
PU LT 90 FD 158 RT 90 BK 119 PD
REPEAT 2 [FD 238 RT 90 FD 316 RT 90]
PU HOME
TELL [0 1 2 3] PU BK 110
TELL 0 LT 90 FD 60 RT 90
TELL 1 LT 90 FD 20 RT 90
TELL 2 LT 90 FD 20 RT 90
TELL 3 LT 90 FD 60 RT 90
TELL [0 1 2 3] ST
END

TO VANISH
TELL [0 1 2 3] HT HOME
SETSP 0 CT CS FS
END

TO RACE
SET.UP
RUN.RACE
END
```

It is pretty easy to understand what VANISH does. It clears the screen. But what does SET.UP do? Can you tell what it will do before you type it into the computer?

Think about it! Go get a pencil and see if you can draw what the screen will look like. When you're finished, type it into the computer. Were you right?

The next thing to do is run the race.

```
TO RUN.RACE
TELL [0 1 2 3] SETSP 10
ASK RANDOM 4 [SETSP RANDOM 100]
WINNER
RUN.RACE
END

TO WINNER
WHEN OVER 0 0 [TELL 0 CONGRATS]
WHEN OVER 1 0 [TELL 1 CONGRATS]
WHEN OVER 2 0 [TELL 2 CONGRATS]
WHEN OVER 3 0 [TELL 3 CONGRATS]
END
```

To run the race, all of the Turtles start with speed set to 10. Then each is given a random speed.

In the WINNER procedure, some questions are asked. What do you think they mean?

Here is where the Collision Detection comes in. You read the first line like this. WHEN Turtle 0 goes OVER the line drawn by pen 0, TELL 0 CONGRATS. WHEN Turtle 1 goes OVER the line drawn by pen 0, TELL 1 CONGRATS. The same thing happens for Turtles 2 and 3.

Why not go back to your Atari manuals and experiment some more with Collision Detection?

But before we leave the race, there are a few more things to do. For one thing, we have to congratulate the winner.

```
TO CONGRATS
SS
(PRINT [Congratulations,] WHO [, you win!])
WAIT 20
VANISH
END
```

SS is the command for SPLITSCREEN. But what's that next line? The parenthesis tell the computer you want to print all of the things inside the parenthesis on one line. WHO is used to find out which Turtle you are talking to.

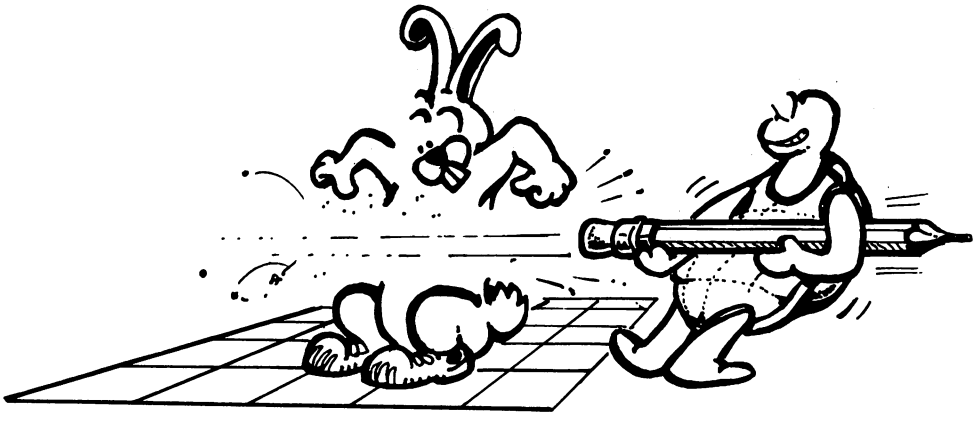
Go ahead, try it! Type in:

```
PRINT WHO
```

What did it say on the screen? How can you change it?

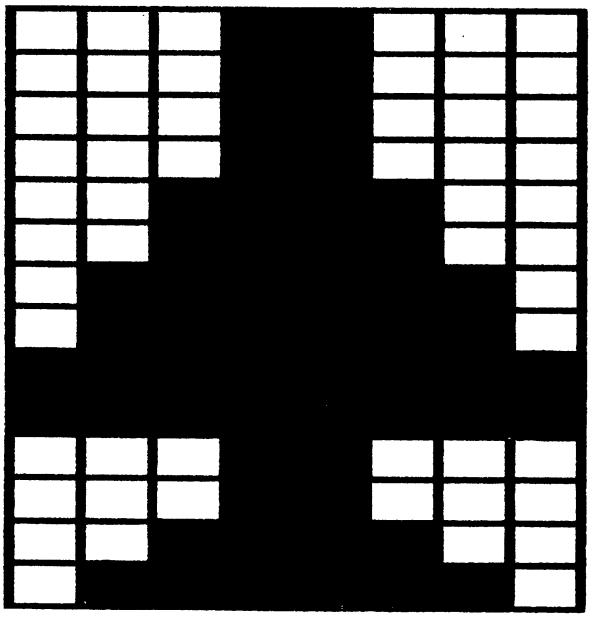
Need a hint? What do you need to TELL the computer?

There is one more thing you need to do for the race. Turtle races are fun, but what about airplane races? Or car races? Or train races?



Why not change the shape of the Turtle into whatever you want it to be? Just for fun, let's make the Turtle into an airplane.

Enter EDSH 1. That means you are going to EDit SHape #1. When the grid appears on the screen, fill it in like this using the CTRL and arrow keys with the space bar.



Once you have completed making the shape you want, hit the ESC key. Then let's change the procedures to use these new shapes. We'll put this into the SET.UP procedure.

The first thing to do is name the shape. And so, let's add the line:

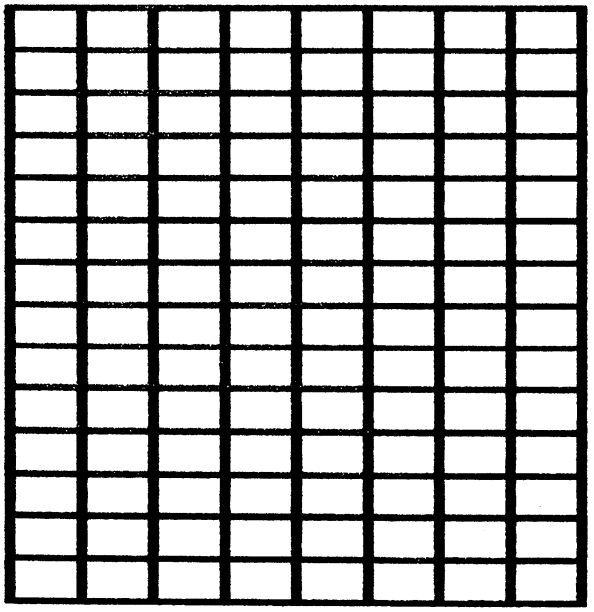
```
MAKE "PLANE GETSH 1
```

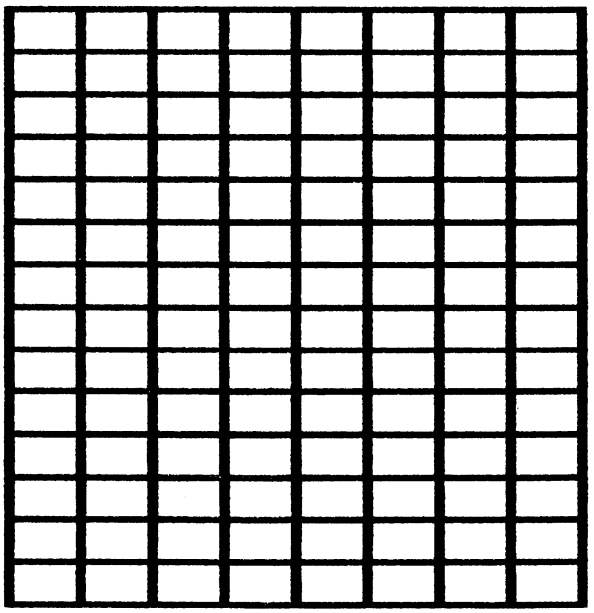
Then tell each of the Turtles to SETSHape 1.

There! Now you can race four airplanes across the screen.

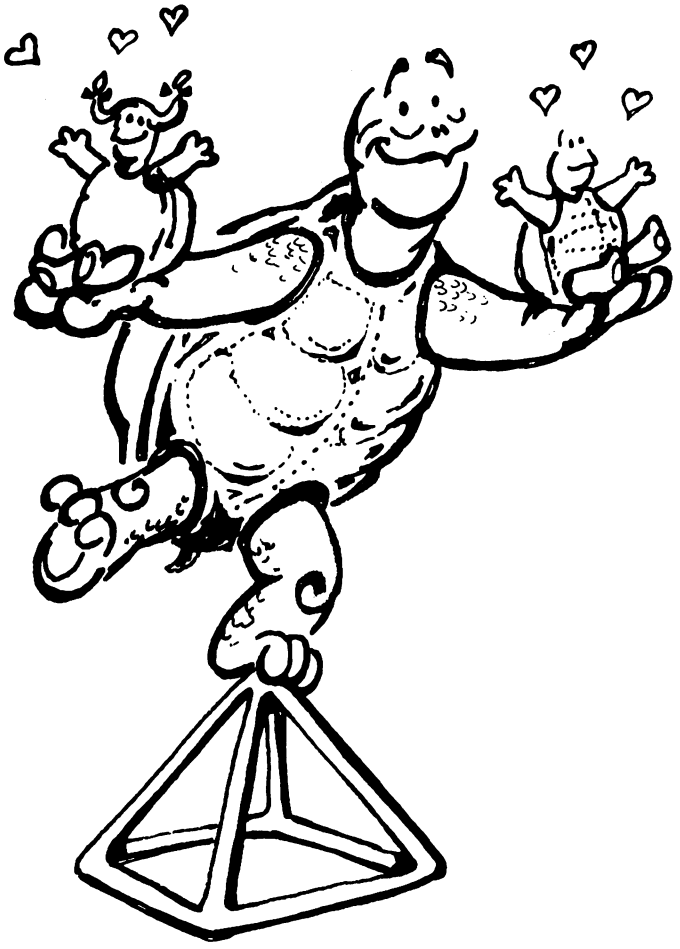
What other shapes can you think up for the turtle?

Here, try it out.



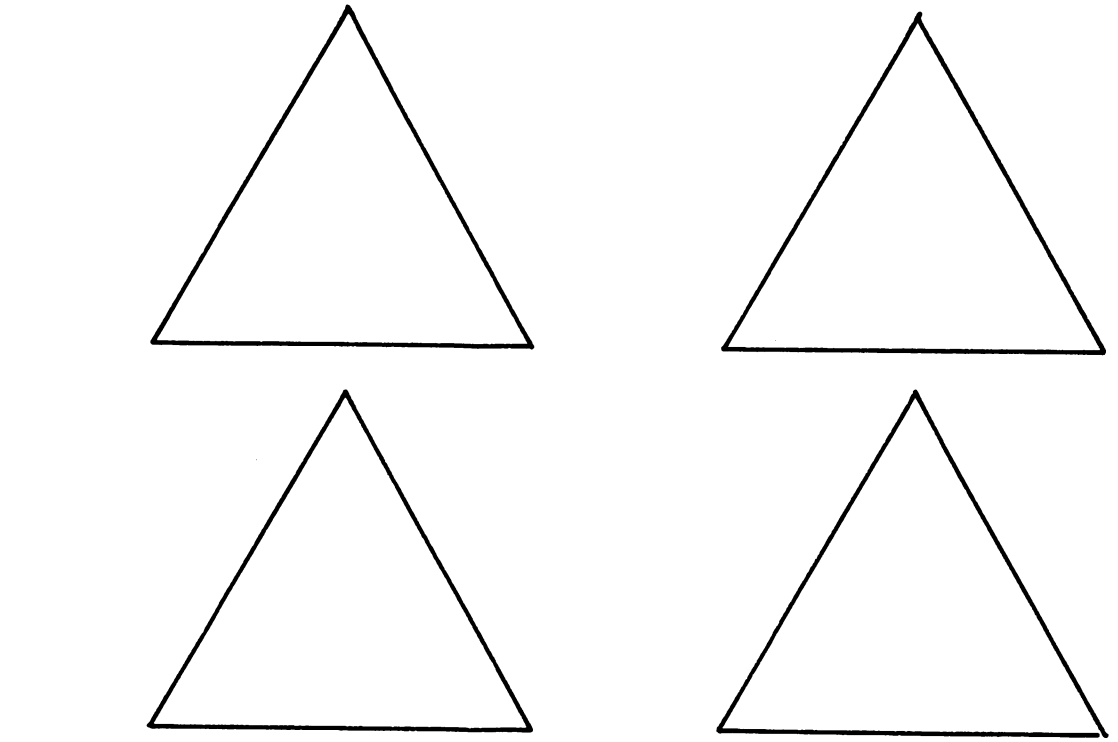


CHAPTER 7
MORE IDEAS

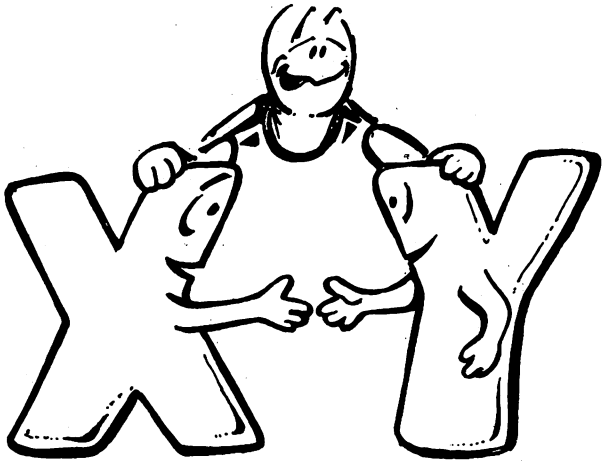


Seven was an idea that grew and grew.
I love my turtles and hope you do, too!

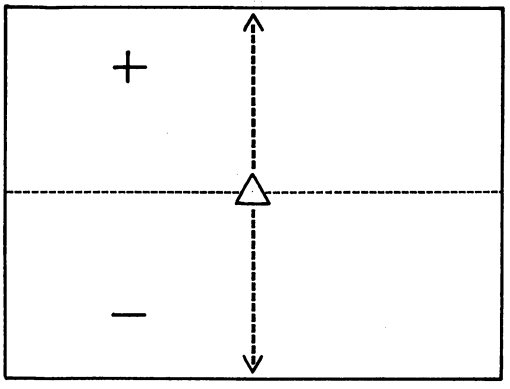
Here is a whole Indian Village of teepees. Draw a different design on each one and then have the Turtle draw one on the screen. (Don't forget to add some color!)



Suppose you want to draw a whole Indian village on the screen. There are two different ways to move the turtle to the position where you want him to start drawing. You already know one. Use PENUP and PENDOWN and move him with FD, BK, RT and LT. You can also tell the turtle exactly where to go with X and Y coordinates.



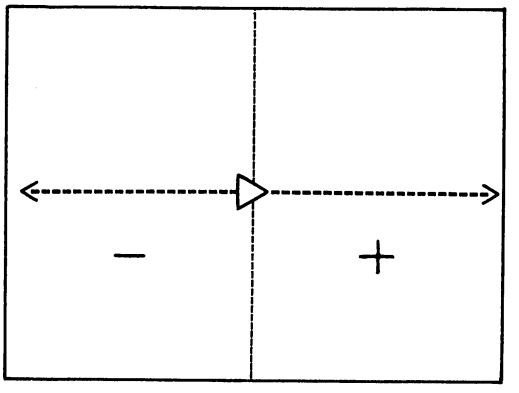
Let's start with Y. Remember earlier when you figured out how many steps the turtle could take from HOME to the top of the screen and how far he could go to the bottom of the screen? Think of the steps above the HOME position as positive, or plus, and those below as negative, or minus. You can tell the turtle where to move by SETY followed by a space and either a positive or negative number. So, put the PENUP and hop your turtle!



SETY 40
SETY -113
SETY 0
SETY 82

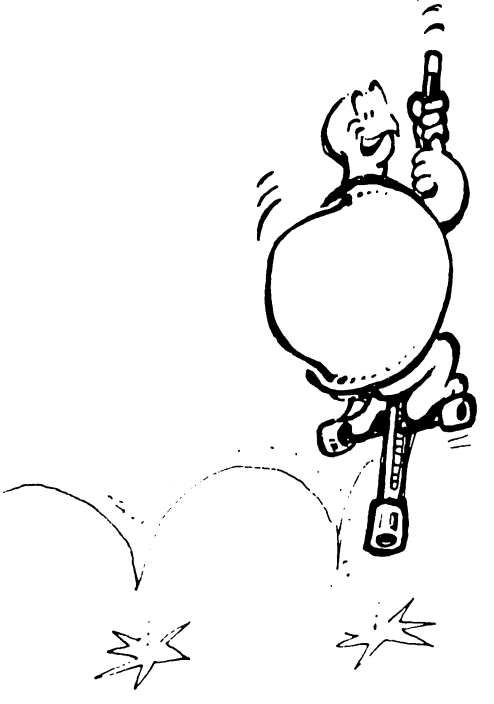
_____ ____
_____ ____

What about side to side? We'll use the X positions to take care of that. The positions to the right of HOME are positive and those to the left are negative. Use SETX followed by a positive or negative number and watch the turtle hop from side to side:




```
SETX 71
SETX -15
SETX 90
SETX -85
_______ ___
_______ ___
```

What do you suppose will happen if you give the turtle a Y command followed by an X command? Try it! See if you can figure out how to hop the turtle from corner to corner! If you can do it, you're in line for the famous Hopping Turtle Award!



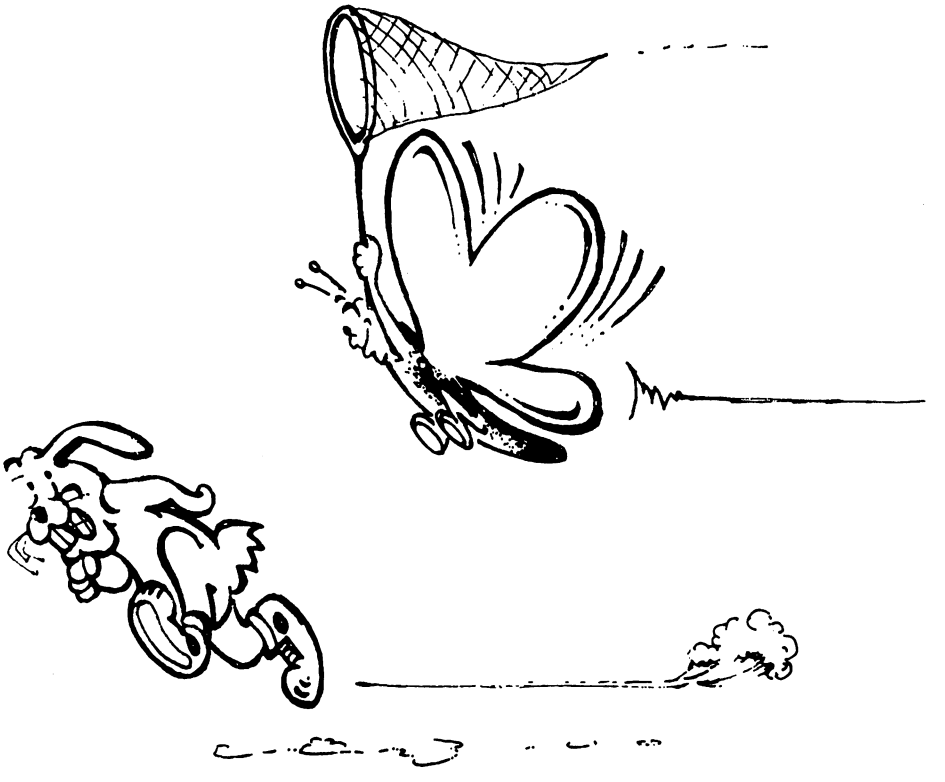
Now that you have the Hopping Turtle Award, let's see if we can make up another game to get some practice at X and Y coordinates. In fact, this game is going to give you practice at a lot of the things we have been doing plus some new things to do.

```
TO ZAP
CT SETCURSOR [ 0 5]
PRINT [WELCOME TO THE GAME OF...]
SETCURSOR [0 7]
PRINT [* * * * * ZAP THE TURTLE * * * * *]
PRINT ""
PRINT [ONE OF THE TURTLES WILL APPEAR SOME -]
PRINT [WHERE ON THE SCREEN. CAN YOU GUESS]
PRINT [THE COORDINATES TO ZAP THE TURTLE?]
PRINT ""
PRINT [TO PLAY, PRESS 'T AND THEN RETURN.]
END

TO T
CS CT PU
TELL [0 1 2 3] HOME
MAKE "ANS1 ( RANDOM 135 ) - ( RANDOM 135 )
MAKE "ANS2 ( RANDOM 115 ) - ( RANDOM 70 )
ASK 2 [PU SETPOS LIST  :ANS1  :ANS2]
GAME
END

TO GAME
TELL [0 1] PX HOME
PRINT [CAN YOU ZAP THE TURTLE?]
WAIT 80 CT
PRINT [GUESS THE X COORDINATE?]
MAKE "ANS3 READNUMBER
PRINT [GUESS THE Y COORDINATE?]
MAKE "ANS4 READNUMBER
ASK 1 [SETPOS LIST  :ANS3  ANS4]
WAIT 20
IF  ANS3 < :ANS1 - 5 [GAME]
IF  ANS3 > :ANS1 + 5 [GAME]
IF  ANS4 < :ANS2 - 5 [GAME]
IF  ANS4 > :ANS2 + 5 [GAME]
CHEERS
END
```

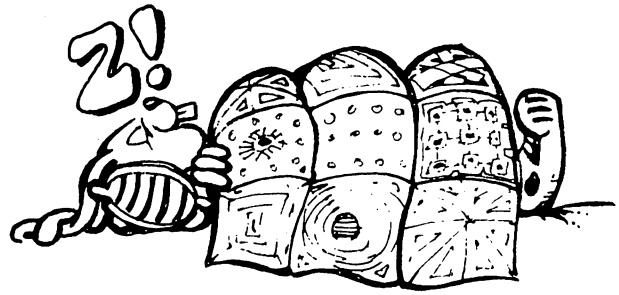
```
TO READNUMBER
OUTPUT FIRST RL
END

TO CHEERS
CT
REPEAT 5 [PRINT [CONGRATULATIONS!]]
FLASH O T
END

TO FLASH  :C
SETBG  :C WAIT 10
MAKE "C  :C + 7
IF  :C  > 70 [SETBG 74 STOP]
FLASH  :C
END
```

A giant caterpiller just crawled across the screen

and then turned into a beautiful butterfly.



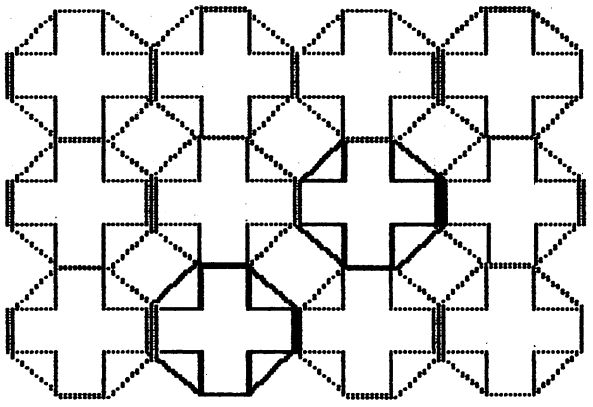
Study the pattern on a linoleum floor or some wallpaper or one of your Grandmother's quilts — anything that has repeating shapes. Design a repeating pattern and then see if you can help the Turtle draw one on the screen.



Here is a procedure to help you along. It will print a randomly colored quilt pattern on the screen. Take a look at this one and then see what kind of quilt patterns you can make.

```
TO BEGIN
FULLSCREEN
START
QUILT 2
END

TO START
PU
SETX -100
SETY -30
PD
END

TO CROSSTOWER :T
IF :T = 0 [STOP]
COLOR
CROSS
AROUND
PU FD 40 PD
CROSSTOWER :T - 1
END

TO DOWN
PU BK 40 RT 90 FD 80 RT 90 FD 40 PD
END

TO UP
PU BK 40 LT 90 FD 40 LT 90 FD 40 PD
END

TO CROSS
REPEAT 4 [SIDE LT 90]
END

TO AROUND
FD 20 RT 90 FD 20
REPEAT 3 [MOVE1 MOVE2]
MOVE1
LT 42
END
```

```
TO MOVE1
RT 42 FD 29
END

TO MOVE2
RT 48 RD 20
END

TO SIDE
REPEAT 2 [FD 20 RT 90] FD 20
END


TO COLOR
SETPC 1 + RANDOM 120
END

TO QUILT  :X
IF  :X = 0 [STOP]
CROSSTOWER 3
DOWN
CROSSTOWER 3
UP
QUILT  :X - 1
END
```



What about adding some music?

Atari LOGO allows you to do a lot of different things with music and sounds. The more you experiment, the more you'll find there is for you to do.

You can play music in two "voices," 0 or 1. You have to tell each voice the note to play, how loud you want it to be, and how long the computer should hold it. The command you use is TOOT.

TOOT voice note volume duration

Voice: Enter 0 or 1

Note: Enter any frequency between 14 to 64,000.

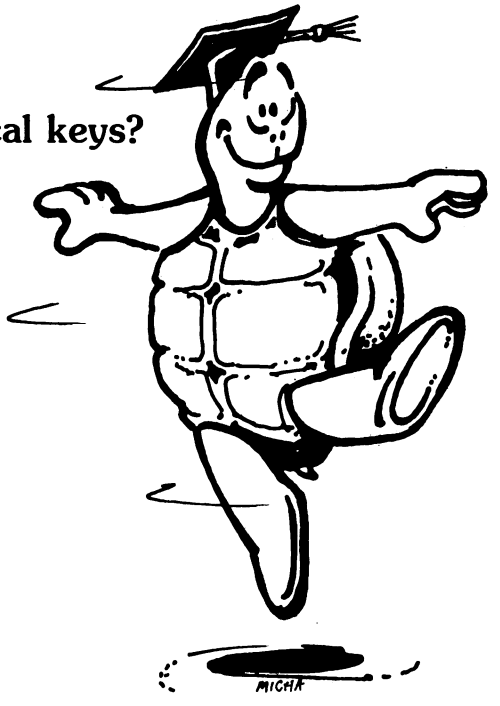
Volume: Enter a number between 0 and 15.

Duration: the duration, or length of time the computer plays the note, can be from 0 to 255. A duration of 60 is one second.

Here are some of the frequencies for notes you'll need to play your favorite tunes:

FREQUENCY	NOTE:
220	A (below Middle C)
223	A#
247	B
262	C (Middle C)
277	C#
294	D
311	D#
330	E
349	F
370	F#
392	G
415	G#
440	A
466	A#
494	B
523	C (above Middle C)
554	C#
587	D
622	D#
659	E
698	F
740	F#
784	G
831	G#

Want to turn your keyboard into musical keys?




```
TO SONG
FREQ
SONG
END


TO FREQ
MAKE "KEY RW
IF  :KEY = " [STOP]
IF  :KEY = "C [MAKE "V 262]
IF  :KEY = "D [MAKE "V 294]
IF  :KEY = "E [MAKE "V 329]
IF  :KEY = "F [MAKE "V 349]
```

```
IF  :KEY = "G [MAKE "V 392]
IF  :KEY = "A [MAKE "V 440]
IF  :KEY = "B [MAKE "V 494]
IF  :KEY = "C [MAKE "V 523]
TOOT 0  :V 15 20
MAKE  "V 32456
TOOT 0  :V 0 2
END

TO RW
OUTPUT FIRST RL
END
```

Now that you have played the scales on the computer, why not combine all seven chapters into one procedure. Here you have music, color, four turtles, random graphics, collision detection, and a lot of fun. Go ahead, try it.

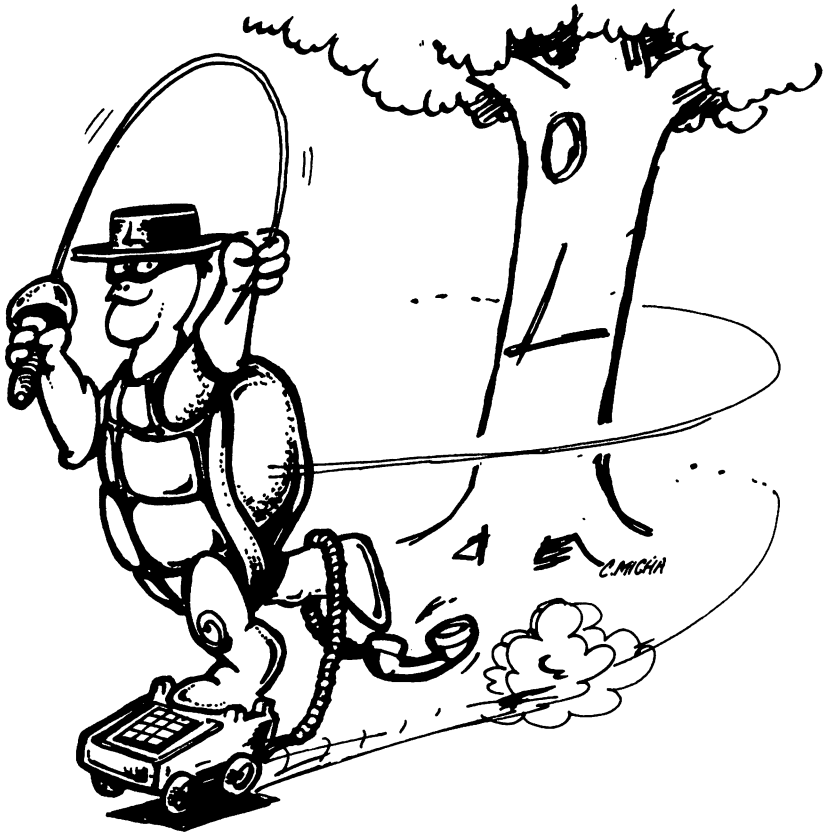
```
TO SET.UP
CS CT
TELL [0 1 2 3] ST PU
TELL 0 SETX 60 SETY 60
TELL 1 SETX -60 SETY 69
TELL 2 SETX -60 SETY -60
TELL 3 SETX 60 SETY -60
TELL [0 1 2 3] PD
END

TO SOUNDFUN
SET.UP
FUN
END

TO CHEERS
TELL [0 1 2 3] HT PU CS HOME
PRINT [OUCH!]
WAIT 20
SOUNDFUN
END
```

```
TO TOUCH?
IF COND 16 [CHEERS]
IF COND 17 [CHEERS]
IF COND 18 [CHEERS]
IF COND 19 [CHEERS]
IF COND 20 [CHEERS]
IF COND 21 [CHEERS]
END

TO FUN
MAKE "FREQ ( RANDOM 1000 + 14 )
TOOT O  :FREQ RANDOM 15 RANDOM 100
MAKE "COLOR RANDOM 125
SETBG  :COLOR
MAKE "TURT RANDOM 4
TELL  :TURT
FD RANDOM 100
RT RANDOM 360
TOUCH?
TYPE [THE SOUND FREQUENCY IS\]
PR  :FREQ
TYPE [THE BACKGROUND COLOR IS\]
PR  :COLOR
WAIT 100
CT
FUN
END
```

You have now seen many of the things Atari Logo can do. But there is a lot more. Why not go back through your Funbook and practice all of the things you have learned. Experiment! Experiment! Experiment!

Then why not share your Logo adventures with others — across town, across the country, and around the world. Do you have a modem connected to your computer? Why not call The Midnight Turtle? He runs the electronic bulletin board for the Young Peoples' Logo Association, roaming the telephones every night, from 7 p.m. to 7 a.m., Central Time. You can reach The Midnight Turtle at (214) 783-7548.

Or write and tell us what you're doing. We'd love to hear from you.



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